CANADA
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS SERVICE

EXPERIMENTAL STATION

LETHBRIDGE

ALBERTA

SUPERINTENDENT, A. E. PALMER, B.Sc., M.Sc.

PROGRESS REPORT 1947-1952

Aerial view of contour and strip farming for wind and water erosion control at the District Experiment Substation, Nobleford, Alberta.

Published by authority of the Right Hon. JAMES G. GARDINER, Minister of Agriculture, Ottawa, Canada

10 M-18306-4-54

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CONTENTS

84780—2

PROGRESS REPORT 1947-1952

Experimental Station—Lethbridge, Alberta

INTRODUCTION

The Lethbridge Experimental Station was established in 1906 on 400 acres of virgin treeless prairie donated by the Alberta Railway and Irrigation Company. The size of the Station has been increased from time to time, and with 95 acres obtained from the Alberta Government in 1949 it occupies 1,077 acres, of which 659 are irrigable. Throughout the entire history of the Station, investigations in both dry and irrigated farming have been conducted.

The six years covered by this report represent a period of prosperity and expansion. Yields of field crops and prices of farm products have been satisfactory. Soil drifting has not been serious. The St. Mary Dam was officially put into operation in 1952, providing the first of a series of reservoirs and canals that may ultimately permit the irrigation of a million additional acres in southern Alberta.

To meet the ever-increasing needs for agricultural information, the research facilities and staff of the Station have been increased. A new livestock unit has been built, including a conventional dairy barn, a loose housing barn, a sheep barn, and a beef cattle barn. A nutrition laboratory and a nutrition barn were constructed to round out a rather complete livestock research unit. To serve the important canning industry, a plant processing laboratory was constructed and furnished with facilities for canning, freezing, and cooking. Two modern greenhouses were completed in 1952 to assist in plant breeding work. Poultry research has been facilitated by the construction of a new laying house. The technical staff numbers 35, as compared with 16 six years ago.

SOUTHERN ALBERTA CLIMATE

The area served by this Station covers a wide range of climatic conditions. The main climatic characteristics are the Chinook wind, the abundant sunshine and the relatively low precipitation with high evaporation.

Precipitation increases from east to west with an annual average of 10·2 inches at Bindloss on the east boundary, 13·8 inches at Foremost in the southeast, 15·6 inches at Drumheller in the north, and 21·3 inches at Pincher Creek in the foothills to the west. The 51-year average at Lethbridge is 16·0 inches. These differences in precipitation are caused, to a certain extent, by the topographical features of which the most important are the Rocky Mountain foothills to the west, the Milk River Ridge which extends across most of the southern boundary, and the Cypress Hills in the southeast. All these heights of land have greater precipitation than the lower areas some distance from them. Directly related to precipitation and its effectiveness is the dry warm Chinook wind which sweeps over the southern prairies from the southwest. It removes snow to permit winter grazing, but also increases evaporation and the hazard of soil drifting.

The average precipitation in the period 1947-52, inclusive, is 17·4 inches with 25·2 inches being recorded in 1951, the highest on record with the exception of 27·9 inches in 1902.

84780—2½

TABLE 1.—WEATHER SUMMARY.—DOMINION EXPERIMENTAL STATION, LETHBRIDGE, ALBERTA

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Temperature (°F.)													
51-year av. daily maximum	27·4	30·0	39·6	55·3	63·8	70·7	78·8	76·7	66·5	57·2	42·1	31·9	53·3
51-year av. daily minimum	5·6	7·4	16·5	29·0	38·2	45·7	50·3	47·7	40·1	31·7	20·0	11·5	28·7
51-year av. daily mean	16·5	18·7	28·0	42·2	51·0	58·2	64·5	62·2	53·3	44·4	31·2	21·7	41·0
51-year av. monthly extreme high	51·4	54·3	62·1	75·7	82·0	86·4	92·5	91·3	84·3	77·6	63·5	54·5	
51-year av. monthly extreme low	−24·7	−23·7	−12·3	11·5	25·6	34·8	40·4	36·8	26·0	13·6	−7·2	−19·8	
Precipitation (inches)													
51-year average	0·68	0·73	0·93	1·12	2·29	2·86	1·69	1·56	1·67	1·01	0·78	0·71	16·02
Evaporation (inches)													
29-year average	......	......	......	......	4·55	4·65	6·05	4·99	3·38	2·38	......	......	......
Wind (miles per hour)													
32-year average	14·1	12·8	12·5	13·4	12·2	10·6	9·4	9·0	10·3	12·6	13·1	13·9	12·0
Bright Sunshine (daily hours)													
44-year average	3·20	4·38	5·22	7·08	8·30	9·23	10·97	9·64	6·95	5·42	3·71	3·02	6·43

Summary of frost data 1902-1952 (inclusive)

	51-year average
Last frost in spring	May 22
First frost in fall	Sept. 14
Number of frost-free days	115
Last killing frost in spring	May 9
First killing frost in fall	Sept. 26
Number of crop days	140

Note: 1.32° or less considered as frost.
2.28° or less considered as killing frost.

Summary of Extremes 1902-1952 (inclusive)

Latest last frost of spring	June 27, 1951—31°
Earliest last frost of spring	April 26, 1940—30°
Earliest first frost of fall	Aug. 14, 1928—31°
Latest first frost of fall	(Oct. 14, 1938—27·8° (Oct. 14, 1940—23°
Latest last killing frost of spring	June 1, 1951—26°
Earliest last killing frost of spring	April 11, 1915—28°
Earliest first killing frost of fall	Sept. 6, 1929—28°
Latest first killing frost of fall	Oct. 22 1947—19·5°
Shortest crop season	1921—110 days
Longest crop season	1940—178 days
Shortest frost-free season	1910 and 1915— 80 days
Longest frost-free season	1940—171 days

TABLE 2.—PRECIPITATION RECORDS

(Monthly and Annual Precipitation Records in Inches 1902–1952, inclusive, with 51-Year Averages and Monthly Extremes for the Same Period)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total annual snowfall	Total annual rainfall	Total annual precip.
1902....	0·67	1·03	0·48	0·02	11·27	5·68	5·95	0·69	0·84	0·02	0·43	0·84	34·5	24·47	27·92
1903....	0·62	0·79	0·89	0·33	2·95	1·12	1·86	3·21	1·60	0·17	0·58	0·70	65·2	8·30	14·82
1904....	0·50	0·90	1·03	0·41	2·86	1·80	0·96	1·19	0·52	0·85	0·03	0·35	30·3	8·37	11·40
1905....	1·45	0·05	0·74	0·56	1·33	2·68	1·44	1·99	0·80	1·13	1·36	0·25	49·5	8·83	13·78
1906....	0·22	0·20	0·54	1·30	8·60	2·31	0·83	4·70	0·16	1·93	0·81	0·88	42·0	18·28	22·48
1907....	1·52	0·30	0·34	1·08	1·14	3·64	1·43	2·30	3·24	0·05	0·14	0·32	61·3	9·37	15·50
1908....	0·27	0·75	0·79	0·69	2·60	7·01	0·42	0·90	0·58	0·57	Nil	0·36	25·0	12·44	14·94
1909....	0·30	0·20	0·50	1·15	4·01	0·82	1·54	0·08	0·47	0·37	0·46	0·42	37·7	6·55	10·32
1910....	0·24	0·83	0·17	0·28	0·79	0·53	0·09	1·07	1·95	0·60	0·41	0·94	27·1	5·19	7·90
1911....	0·70	0·52	0·32	0·82	1·90	4·70	2·27	3·63	4·16	0·57	0·95	0·77	40·9	17·22	21·31
1912....	0·69	0·40	0·44	0·20	0·66	1·73	2·78	1·41	2·61	1·07	0·99	0·23	34·2	9·79	13·21
1913....	0·80	0·30	0·42	0·52	1·70	4·70	1·29	1·93	1·65	0·50	0·36	Nil	24·6	11·71	14·17
1914....	1·55	0·96	1·12	0·54	0·29	2·48	0·93	3·59	1·07	2·17	0·63	1·19	65·7	9·95	16·52
1915....	0·50	0·94	0·22	0·04	3·03	4·84	3·44	0·96	1·32	0·96	0·75	0·27	28·2	14·45	17·27
1916....	1·09	0·86	0·90	0·46	3·77	3·54	3·33	2·97	4·66	1·99	0·49	0·51	55·3	19·04	24·57
1917....	0·73	0·27	0·10	1·57	0·95	1·42	1·37	2·00	1·67	0·82	Nil	1·13	40·8	7·95	12·03
1918....	0·46	0·76	0·66	0·13	0·58	0·76	0·85	1·23	1·07	0·24	0·43	0·46	27·4	4·89	7·63
1919....	0·06	0·95	0·75	0·47	1·75	0·56	1·06	1·05	2·04	1·78	1·26	0·55	49·9	7·29	12·28
1920....	0·84	1·21	0·89	4·37	1·66	0·40	2·59	0·20	0·05	0·99	0·06	0·79	79·4	6·11	14·05
1921....	0·56	0·47	1·42	1·19	0·96	1·04	3·23	0·46	1·29	0·23	1·73	0·19	56·0	7·17	12·77
1922....	0·43	0·41	0·81	2·57	0·89	1·87	2·30	0·40	0·81	0·78	0·47	0·60	44·7	7·87	12·34
1923....	0·48	0·42	0·75	1·09	3·48	4·45	2·55	1·01	0·18	0·55	0·53	0·91	36·6	12·74	16·40
1924....	0·66	1·04	0·69	0·56	1·17	3·82	0·54	2·91	1·46	0·59	1·02	1·54	51·6	10·84	16·00
1925....	0·30	0·99	2·26	1·99	0·43	3·40	0·82	1·85	4·86	1·08	0·16	0·62	46·4	14·12	18·76
1926....	0·26	0·70	0·11	0·34	0·64	4·67	1·15	2·31	4·62	0·31	0·52	0·56	27·3	13·46	16·19
1927....	0·31	1·39	0·37	1·48	7·32	1·60	1·93	1·74	3·29	0·58	2·88	0·96	73·9	16·46	23·85
1928....	0·94	0·79	0·93	1·32	0·09	6·79	3·98	1·54	0·24	0·85	0·28	0·33	50·0	13·08	18·08
1929....	1·08	0·63	1·34	2·55	2·63	3·72	0·52	0·59	2·05	2·20	0·49	1·91	81·6	11·55	19·71
1930....	0·37	0·20	0·77	1·53	1·54	1·42	1·87	0·57	2·36	0·58	0·92	0·21	24·8	9·86	12·34
1931....	0·01	0·25	1·40	1·12	1·22	1·55	1·09	0·19	1·99	0·66	1·21	0·73	54·9	5·93	11·42
1932....	0·81	0·55	1·05	2·73	2·99	2·06	0·74	3·63	1·00	1·07	1·87	0·74	55·5	13·69	19·24
1933....	0·33	0·38	2·51	2·49	1·80	1·32	0·92	2·64	1·30	2·44	0·77	2·27	120·3	7·14	19·17
1934....	0·43	0·31	2·30	0·13	0·71	4·00	0·43	0·60	2·97	1·70	1·11	0·59	63·3	8·95	15·28
1935....	0·47	0·72	1·09	2·46	1·42	0·35	0·70	1·18	0·22	1·70	0·52	0·47	67·7	4·53	11·30
1936....	1·19	0·62	0·98	0·78	2·01	1·89	0·41	0·90	1·39	0·69	0·48	1·40	54·9	7·25	12·74
1937....	1·76	0·42	0·79	0·45	2·38	3·19	2·91	0·86	1·10	1·33	0·70	0·38	44·7	11·80	16·27
1938....	0·91	0·80	1·85	0·88	3·21	1·16	1·28	1·72	0·81	0·96	1·93	0·22	60·5	9·68	15·73
1939....	0·12	0·88	0·74	0·68	1·66	6·42	0·58	0·38	2·10	0·96	0·29	0·82	34·5	12·18	15·63
1940....	0·03	1·43	0·63	3·47	1·32	1·25	1·72	0·39	1·57	1·37	1·03	0·38	36·6	10·93	14·59
1941....	0·96	0·68	0·71	1·09	1·96	2·67	4·09	1·80	2·82	0·25	0·36	0·34	34·7	14·26	17·73
1942....	0·11	1·21	0·64	1·06	4·61	4·34	3·22	1·00	1·49	0·20	1·44	0·26	38·1	15·77	19·58
1943....	1·06	0·67	0·83	0·81	1·33	0·90	1·46	1·15	0·83	1·11	0·10	0·03	34·7	6·81	10·28
1944....	0·10	1·33	1·08	1·08	1·52	1·76	2·92	1·69	1·05	Nil	2·00	0·57	55·4	9·56	15·10
1945....	0·70	1·33	0·82	1·14	3·18	3·48	1·17	0·88	3·26	0·51	0·91	1·65	71·9	11·84	19·03
1946....	0·54	0·29	0·30	0·43	2·18	4·43	1·01	1·49	1·97	4·37	2·51	1·48	76·5	13·35	21·00
1947....	0·77	1·41	2·10	1·61	0·56	4·24	0·35	2·77	3·45	0·96	1·01	0·72	90·4	10·91	19·95
1948....	0·90	1·68	1·39	1·14	4·24	6·06	2·02	0·10	Nil	0·52	0·55	0·35	50·6	13·89	18·95
1949....	1·62	0·91	1·63	0·15	3·70	1·30	0·96	0·46	0·62	2·55	0·08	1·46	88·7	6·57	15·44
1950....	1·15	0·32	1·51	1·00	0·91	1·33	1·77	0·78	0·89	0·97	1·20	0·59	59·4	6·48	12·42
1951....	1·18	0·99	1·17	2·74	1·28	6·28	0·94	3·74	2·14	2·46	0·15	2·12	97·5	15·44	25·19
1952....	0·69	0·55	1·12	0·20	1·65	2·51	2·03	2·58	0·35	0·27	0·51	0·04	29·6	9·54	12·50
51-Year Averages (1902–1952 inclusive)															
	0·68	0·73	0·93	1·12	2·29	2·86	1·69	1·56	1·67	1·01	0·78	0·71	51·6	10·86	16·02
Extremes for the 51-Year Period 1902-1952															
Low....	0·01	0·05	0·10	0·02	0·09	0·35	0·09	0·08	Nil	Nil	Nil	Nil	24·6	4·53	7·63
Year...	1931	1905	1917	1902	1928	1935	1910	1909	1948	1944	1917	1913	1913	1935	1918
High...	1·76	1·68	2·51	4·37	11·27	7·01	5·95	4·70	4·86	2·55	2·88	2·27	120·3	24·47	27·92
Year...	1937	1948	1933	1920	1902	1908	1902	1906	1925	1949	1927	1933	1933	1902	1902

NOTE:—Ten inches snow is assumed equal to one inch of rain.

TABLE 3.—OCCURRENCE OF FROST AND FROST-FREE PERIODS

(Frost: 32°F. or lower; Killing Frost: 28°F. of lower)

Year	Last frost in spring		First frost in fall		No. of frost-free days	Last killing frost in in spring		First killing frost in in fall		No. of killing frost free days
	Date	Temp.	Date	Temp.		Date	Temp.	Date	Temp.	
		°F		°F			°F		°F	
1902	May 9	32·0	Aug. 29	31·9	112	Apr. 25	20·5	Sept. 20	27 5·	148
1903	May 22	29·6	Sept. 13	31·1	114	May 21	26·0	Sept. 30	26·5	132
1904	May 25	29·9	Sept. 13	27·1	111	Apr. 18	25·0	Sept. 13	27·1	148
1905	May 19	32·0	Sept. 30	28·8	134	May 5	28·0	Oct. 10	24.8·	158
1906	May 27	32·0	Aug. 25	31·2	90	May 8	28·0	Oct. 21	23·0	116
1907	May 13	23·0	Sept. 11	31·9	121	May 13	23·0	Sept. 13	24·2	123
1908	May 2	32·0	Sept. 23	32·0	144	Apr. 30	26·5	Sept. 26	19·2	149
1909	May 29	29·8	Aug. 28	29·8	91	May 8	25·4	Sept. 14	26·8	129
1910	June 4	31·6	Aug. 23	31·5	80	May 20	27·4	Sept. 12	26·3	115
1911	May 28	29·6	Aug. 27	29·4	91	May 1	25·2	Sept. 23	26·3	145
1912	June 6	28·3	Sept. 15	23·9	101	May 4	24·5	Sept. 15	23·9	134
1913	May 12	29·2	Sept. 12	32·0	123	May 6	24·8	Sept. 24	26·2	141
1914	May 12	29·8	Sept. 15	31·0	126	May 11	24·1	Oct. 7	20·1	149
1915	May 16	30·8	Sept. 11	31·2	118	Apr. 11	28·0	Sept. 12	26·5	154
1916	May 23	31·6	Sept. 14	31·2	114	May 13	25·0	Sept. 28	24·0	138
1917	June 4	31·0	Sept. 1	32·0	89	May 30	28·0	Sept. 29	27·0	122
1918	June 6	32·0	Sept. 15	28·0	101	May 26	21·0	Sept. 15	28·0	112
1919	June 1	31·0	Sept. 26	32·0	117	May 14	27·0	Sept. 29	26·0	138
1920	June 3	29·0	Sept. 19	30·0	108	May 30	26·0	Sept. 26	24·0	119
1921	May 31	30·0	Sept. 9	32·0	101	May 28	24·0	Sept. 15	28·0	110
1922	May 23	29·0	Oct. 2	32·0	132	May 6	28·0	Oct. 11	21·0	158
1923	May 29	29·5	Sept. 11	29·0	105	May 15	28·0	Sept. 22	25·0	130
1924	May 26	31·5	Sept. 20	28·5	117	May 6	25·5	Sept. 26	26·0	143
1925	May 17	30·0	Sept. 20	25·5	126	May 11	24·0	Sept. 20	25·5	132
1926	June 9	32·0	Sept. 11	30·0	94	May 2	28·0	Sept. 20	26·0	141
1927	May 18	32·0	Sept. 8	32·0	113	May 9	26·0	Sept. 26	29·0	140
1928	May 14	31·0	Aug. 14	31·0	92	Apr. 22	28·0	Sept. 8	26·0	139
1929	May 19	32·0	Sept. 6	28·0	110	May 15	24·0	Sept. 6	28·0	114
1930	May 23	32·0	Sept. 23	32·0	123	Apr. 21	29·0	Oct. 15	17·0	177
1931	May 21	32·0	Sept. 14	32·0	116	May 19	28·0	Sept. 23	35·0	127
1932	May 28	31·0	Sept. 3	32·0	98	May 15	29·0	Sept. 21	29·0	129
1933	May 20	30·0	Sept. 24	32·0	127	Apr. 20	20·0	Sept. 26	27·0	159
1934	May 12	32·0	Sept. 14	29·0	125	May 2	28·0	Sept. 20	21·0	141
1935	May 28	32·0	Sept. 26	21·0	121	May 8	26·0	Sept. 26	21·0	141
1936	Apr. 29	31·0	Sept. 14	32·0	138	Apr. 28	22·0	Oct. 1	23·0	156
1937	May 21	32·0	Sept. 24	30·8	126	May 6	25·1	Oct. 5	27·1	152
1938	May 15	30·4	Oct. 14	27·8	152	May 14	29·0	Oct. 14	27·8	153
1939	May 1	31·2	Sept. 25	32·0	147	Apr. 20	26·3	Sept. 29	29·0	162
1940	Apr. 26	30·0	Oct. 14	23·0	171	Apr. 19	18·0	Oct. 14	23·0	178
1941	May 22	30·0	Sept. 8	29·5	109	May 8	27·5	Sept. 25	26·8	140
1942	May 18	27·2	Sept. 18	28·0	123	May 18	27·2	Sept. 18	28·0	123
1943	June 8	32·0	Sept. 2	31·2	86	May 14	24·0	Sept. 8	27·5	117
1944	May 23	31·0	Sept. 19	30·5	120	May 7	28·0	Sept. 30	27·8	147
1945	May 12	32·0	Sept. 17	32·0	128	May 8	27·0	Sept. 24	30·0	139
1946	May 21	30·5	Sept. 23	25·0	125	May 10	16·0	Sept. 23	25·0	136
1947	May 28	24·0	Sept. 17	29·0	112	May 28	24·0	Oct. 22	19·5	147
1948	May 12	30·0	Sept. 6	30·5	117	May 3	26·0	Sept. 24	26·0	144
1949	June 18	32·0	Sept. 11	29·5	85	May 23	28·0	Sept. 12	21·0	112
1950	May 8	26·0	Sept. 11	29·5	126	May 8	26·0	Sept. 13	27·0	128
1951	June 27	31·0	Sept. 15	32·0	80	June 1	26·0	Sept. 24	26·5	115
1952	May 9	32·0	Oct. 4	26·0	148	Apr. 23	28·0	Oct. 4	26·0	164
51-Year Averages (1902–1952 inclusive)										
	May 22		Sept. 14		115	May 9		Sept. 26		140

EXTREMES:

Frost: (32° F. or lower)

Latest last frost of Spring:
June 27, 1951—31°

Earliest first frost of fall:
Aug. 14, 1928—31°

Earliest last frost of Spring:
April 26, 1940—30°

Latest first frost of fall:
Oct. 14, 1940—23°

Longest frost free-season:
1940—171 days

Shortest frost-free season:
1951—80 days

Killing Frost: (28°F. or lower)

Latest first killing frost of fall:
Oct. 22, 1947—19·5°

Earliest last killing frost of spring:
April 11, 1915—28°

Earliest first killing frost of fall:
Sept. 6, 1929—28°

Latest last killing frost of spring:
June 1, 1951—26°

Longest Killing frost-free season:
1940—178 days

Shortest killing frost-free season:
1921—119 days

FIELD HUSBANDRY

Field Husbandry investigations are conducted on both dry and irrigated land. The work on dry land emphasizes soil conservation while that on irrigated land takes into consideration the specialization required in this kind of farming.

Dry Land

Crop Rotations

Good crop rotations provide for systematic cropping of land in a way that will maintain or improve soil fertility and provide adequate returns to the farmer. Rotation studies were established on dry land in 1911 and some of these are still functioning.

Rotation "A"

This rotation of continuous wheat cannot be considered as safe or satisfactory for the Lethbridge area, despite the fact that over a 41-year period an average of 12·2 bushels per acre has been obtained. It has been increasingly difficult to control wild oats in this rotation.

Rotation "B" and Rotation "C"

The two-year Rotation "B" and the three-year Rotation "C" have both given excellent results and, over a 41-year period, the yields of wheat per acre of rotation have both been 13·6 bushels. In very dry years, the two-year rotation has proved more satisfactory than the three-year rotation, since some crop failures have occurred the second year after summerfallowing. It is felt that a combination of these two rotations may be the most satisfactory for this area; the second crop after fallow would be seeded only if the subsoil was moist to a depth of 26 to 30 inches or more at seeding time.

Although certain mixed-farming rotations, which include crops such as peas and oat hay, provide much palatable feed, they have not been so profitable as grain rotations.

New rotations, which include several years of grass and grass-legume mixtures, are now under observation and their effect on crop production and soil conservation is being studied.

Sweet Clover in Dry Land Grain Rotations

Several methods of handling sweet clover in dry land rotations have been tested. The results of 20 years of study indicate that the greatest yields of wheat per acre of rotation, following clover, have been obtained when the clover was cut for hay and the remaining stubble plowed down for fallow. Plowing down an entire clover crop has not been satisfactory on dry land and, in general, the value of sweet clover in dry land rotations appears doubtful where precipitation is less than 14 to 16 inches per year.

Rates of Seeding Barley on Dry Land

A test conducted from 1943 to 1950 indicates that barley should be seeded at a rate of six or seven pecks per acre on dry land summerfallow. At this rate, an average yield of 36·0 bushels per acre has been obtained. At lower rates of seeding, yields were slightly lower and heavy weed infestation in the crop became troublesome. At rates in excess of seven pecks per acre, yields were lowered due to crowding of the crop plants.

The Effect of Commercial Fertilizers on Dry Land Wheat

Commercial fertilizers have been applied to dry land wheat on both summerfallow and stubble in various combinations and at different rates. Fertilizer trials on the Station for the past 40 years, show no worthwhile response from nitrogen or potash. Phosphate, however, frequently stimulated the growth of wheat plants and caused increased stooling early in the season. If there was sufficient moisture throughout the season to maintain uninterrupted growth, there was invariably an increase in production and a hastening of ripening. However, in seasons when crops were injured to any degree by drought, no increase in yields was noted nor was the date of ripening advanced to any appreciable extent. The results indicate that, under good management in this locality, enough nutrients become available each year under dry land conditions to supply the needs of the crops grown under average moisture conditions. The results from the district substations point toward the same conclusions. However, on soils that have not been properly managed in the past, fertilization may prove beneficial. Limited experiments on district dry land farms in recent years have indicated that some response is obtained from the use of a soluble phosphate fertilizer on wheat. This response was especially marked on soils that had been badly drifted.

Plowless Tillage for Dry Land

Plowless tillage has been used for many years under trash cover systems of farming. A comparison of the effect on yield of wheat in a three-year rotation on plowless tillage and plowed tillage has established no great differences in yield per acre of rotation regardless of method of tillage. Yields on fallow have been slightly higher following plowless tillage.

In view of the ever present danger of wind and water erosion on bare soil, plowed fallows cannot justifiably be recommended under most dry land farming systems of the prairies.

After-harvest Cultivation of Stubble

Methods of fall cultivating stubble land, to be seeded the following spring, have been studied for the past 12 years. Cultivation immediately after combining has been an effective means of promoting fall germination of weed seeds and preventing the maturation of others, such as Russian thistle.

Under a system of continuous cropping, an average yield of 15·7 bushels per acre has been obtained following fall tillage with the blade-type cultivator. This implement left the stubble erect to catch the winter snow. Wheat, following basin-listing or one-way disking, yielded only slightly higher than stubble land which received no after-harvest cultivation and produced an average of 14·3 bushels per acre.

Cultural and Cropping Control of Hoary Cress

This work has been under way at the Dalroy Substation since 1946. The infestation consisted mostly of the lens-podded variety of hoary cress, growing on a shallow black loam, some 15 miles due east of the Calgary Airport.

Eradication by continuous cultivation, allowing four to five days re-growth after each operation, was obtained by late summer of the third season. The cultural operations were at 15-day intervals in the first year and 19-day intervals in the second year. Either a blade-type implement or a one-way disk was effectively used to eradicate hoary cress.

Cropping control studies showed barley and spring rye to be better competitors than spring wheat, as judged by interval between cultivations in the subsequent fallow year. On the same basis a three-year rotation, with two years of wheat and one year of fallow, allowed for an apparent increase in vigor of the hoary cress.

Continuous cropping to spring wheat gave little competition, and under such a cropping system the hoary cress infestations increased in size and intensity. Continuous cropping to fall rye gave some slight reduction in vigor of the hoary cress, but not so great a reduction as either spring or fall rye alternating with fallow.

FIG. 1—The self-propelled combine has proved to be an excellent harvesting implement for securing accurate yields on medium to large grain plots.

Seed formation by hoary cress has been prevented by the use of six ounces free acid 2,4-D ester per acre applied at the recommended growth stage of the grain crop. Success was attained only when the pre-seeding cultural operation killed down all existing shoots of the hoary cress infestation.

Reaction of Annual Weeds to 2,4-D

As a general rule, all of the broadleaf annual and winter annual weeds were most readily killed in the seedling stage. Resistance increased with an increase in size and age. Stinkweed, wild mustard, and tumbling mustard remained reasonably susceptible up to the flowering stage. Lambs' quarters was readily killed in the young stage, but resistance to 2,4-D increased rapidly until, at flowering, normal dosage rates affected the plant but seldom gave complete kills. Flixweed and Russian thistle were easily killed in the early vegetative stage, but little killing occurred from treatments applied after the plants were three to four inches tall. Redroot pigweed, tumble weed, and spreading amaranth were fairly resistant, even in the early vegetative stages, and treatments applied after the seedling stage seldom gave satisfactory kills. Wild buckwheat was the most resistant of the broadleaf annuals encountered in the tests, and even in the seedling stage the normal dosage rates caused little more than a temporary setback.

Comparison of the Types of 2,4-D

There are three types of 2,4-D usable for weed control, namely the sodium or ammonium salts, the amine salts, and the esters. The esters are the fastest acting of the three types, and are least affected by the occurrence of rain immediately after application.

The three types are almost equal for killing the most susceptible weed species in their most susceptible growth stages. However, the types differ in their killing action for less susceptible weeds, or weeds that have reached a more resistant stage of growth. For example, it was determined that for the control of Russian thistle treated when two to three inches tall, two ounces of ester 2,4-D was approximately equal to four ounces of amine or eight ounces of sodium salt.

Effects of 2,4-D on Spring Wheat

The spring wheat crop is very susceptible to 2,4-D injury when in the two- and three-leaf stages of growth. Visible head injuries commonly result from treatments made at these growth stages, and some slight yield reduction is likely to occur.

Application of 2,4-D between the time a wheat crop reaches early boot through to the heading stage causes sterility in some of the florets. This sterility reduces crop yields and, in the Lethbridge tests, yield reductions up to 25 per cent have been recorded.

The 2,4-D amines have proved to be slightly less injurious to spring wheat than the 2,4-D esters at equal dosage rates. The choice of 2,4-D type will be governed by the weeds present, amines being preferred for susceptible weeds but esters being most useful for a mixed weed population of susceptible and partially resistant species.

Effects of 2,4-D on Flax

The flax crop is reasonably resistant to 2,4-D when it has attained a height of approximately two inches and retains the resistance to the bud stage. Flax, treated when one to one and one-half inches tall, shows little immediate effect of the 2,4-D application. Treatments made after this early stage through to flowering cause a drooping of the plants within a few hours. Recovery from this drooping occurs within a few days, generally leaving a permanent crook in the stems.

Other types of injury may occur, but the most common evidence of 2,4-D application to flax is a delay in flowering and ripening. Normal dosage rates of the chemical are likely to delay the maturity of the crop from 7 to 10 days.

Amines have proved to be less damaging to the flax crop than the esters when applied at equal rates of free acid equivalent. However, in view of the increased Russian thistle control and the resultant decrease in weed competition obtained from the ester treatments, ester 2,4-D at three ounces free acid per acre has allowed for the production of higher flax yields than has the same rate of amine 2,4-D.

Trash Conservation by Tillage Machinery

The capacity of tillage tools to conserve trash is an important consideration in their selection and use for summerfallowing or seedbed preparation.

Studies at the Station have shown that blade cultivators will conserve 70 per cent or more of the original surface cover after three or four strokes. The heavy-duty cultivators will conserve about 62 per cent and the duckfoot cultivator about 57 per cent of the original surface material after three strokes on summerfallow.

One-way disks will bury about 50 per cent of the surface material on each stroke. Three strokes with the one-way will conserve only 12 per cent of the cover. The flexible one-way disk harrow maintains 18 to 20 per cent after three strokes under normal operating conditions.

The combination of a disk-type implement for the first stroke and the use of a blade cultivator, heavy-duty cultivator or rod weeder, for subsequent strokes will conserve 60 per cent of the original cover. Subsurface cultivators, including the rod weeder, tend to raise buried material to the surface when used for secondary tillage operations.

Seeding Machinery for Spring and Winter Wheat

Studies here for four basic types of seeding mechanisms for use in trash-protected seedbeds have shown no significant yield differences attributable to the drills, provided the technique of use is properly adapted to the requirements of the seeder.

The press drill with double-disk furrow openers has been found to be well adapted for use in trashy seedbeds. On heavily covered stubble fields the use of disk tillage or other cultivation to partially reduce the surface cover has been found advisable. The disks must be free rolling and in good condition to cut through the trash and prevent dragging.

The one-way disk seeder has given excellent results provided the disks cut the trash cleanly. Depth of operation must be properly controlled, and on light and medium soils, a good packer has been found to be essential to ensure uniformity of germination.

The semi-deep furrow drill, of the revised hoe drill type mounted on a press wheel carriage, has given excellent results on a variety of seedbeds, including those prepared by the blade cultivator. Uniform and early emergence has been commonly experienced. In sandy soils covered with large quantities of long straw some dragging has occurred. Additional tillage to break up the trash eliminates dragging. A trash harrow has been found effective for this purpose provided the trash is dry and brittle.

The use of a deep furrow drill for winter wheat has given results equal to those obtained with a press drill. Excluding years of winterkilling, the average yields over a 10-year period are 22·7 bushels and 22·1 bushels per acre respectively. However, two crop failures have been recorded for press drill seeding and only one for deep furrow seeding within this period. The saving of one crop from the cutting action of an early spring storm is a result of the protection of the young plants by the furrows.

The blade seeder has given its best results under conditions where depth can be properly controlled. Operations at depths from two to three inches are recommended where possible. Preseeding cultivation must be gauged to condition the soil for the seeding stroke if uniform depth and a level seeding job is to be obtained. Good results have been obtained when seeding stubble fields without previous preparation. Packing has increased uniformity of emergence under most conditions.

Regardless of the type of seeding mechanisms used, it has been found advisable to ensure that the trash is uniformly spread over the surface of the soil before seedbed preparations are commenced. Excessively heavy piles or windrows of straw have depressed yields on localized areas in the field.

Irrigated Land

Crop Rotations

The first crop rotation undertaken on irrigated land was Rotation "U", started in 1910. This 10-year rotation receives 30 tons of barnyard manure and one-half of each field receives 300 pounds of ammonium phosphate (11-48-0) during each cycle. The rotation consists of six years of alfalfa and one year each of wheat, oats, barley, and sugar beets. The maintenance of a high fertility level through the use of barnyard manure and commercial fertilizer in this legume rotation is shown by continuing high crop yields. The long-term average yield per acre of cereal crops on the fertilized and unfertilized plots, respectively, are: wheat 58·6 and 52·5 bushels; oats 104·2 and 96·2 bushels; barley 74·2 and 64·6 bushels. Results of soil analyses, taken every 10 years, reveal that the organic matter and nitrogen content of the soil on this rotation have increased during the last 42 years.

The effects of bacterial wilt and crown rot, in recent years, have limited the economic production of alfalfa hay on irrigated land to three or four years. For this reason the cropping plan of Rotation "U" was revised in 1951. The six continuous years of alfalfa have been divided into two three-year periods, with two other crop years following each period. However, the same crops are grown and the fertility treatments are maintained as before.

In 1929, three rotations dealing more specifically with sugar beets were begun. They consist of one eight-year rotation, and two four-year rotations. Each of these rotations is conducted under four fertility treatments; manure and fertilizer, manure alone, fertilizer alone, and no additions. The eight-year rotation receives 30 tons and the four-year rotations receive 20 tons of barnyard manure during the cycle of each rotation. Commercial fertilizer is applied for two years during the cycle of each rotation, at the rate of 100 pounds per acre of ammonium phosphate. The fertilizer is drilled in with the sugar beet seed at the time of seeding.

The use of barnyard manure and commercial fertilizer has enabled these rotations to maintain satisfactory yields of all crops after 24 years of cropping. These rotations definitely establish the value of manure and phosphatic fertilizers in sugar beet culture. The highest yield of roots is obtained when both treatments are used together. The greatest decrease in yield of second-year sugar beets as compared with the first year of beets for all three rotations, occurs in the treatment which includes manure only. This confirms the need of sugar beets for phosphorus, without which the root crop cannot be grown economically. Alfalfa yields drop sharply when no phosphatic fertilizer is available. This is borne out by the average yield for the three alfalfa years of 1·88 tons of hay per acre on the fertilized plots compared with 1·00 tons per acre on the check plots. As the fertilizer is applied only with sugar beet crops, the alfalfa was benefiting from it for three to five years after it was applied.

FIG. 2—Manure plowed under in the fall has given high yields on irrigated land.

The residual effects of the manure and fertilizer on the subsequent grain yields are quite apparent. The most outstanding feature of this residual effect appears in the eight-year legume rotation. Eight years after the manure was applied there was still an average annual increase of 9·5 bushels of wheat.

From the standpoint of sugar beets, the eight-year alfalfa rotation yields roots containing lower percentages of sugar than those from the other two rotations. Intensive investigations carried out through soil and plant analysis seem to indicate that nitrogen is the contributing factor for these differences. An abundant supply of soil nitrogen early in the growing season seems to stimulate vegetative growth, and increase the capacity of the plants to produce carbohydrates. But if an excessive supply of nitrogen is maintained during the latter part of the growing season as in the alfalfa rotation, more than a normal amount of nitrogen is taken up. The plants draw on the stored food material for energy to reduce these excess nitrates and this appears to result in a reduced sugar content of beets at harvest time.

In 1947 an experiment was started to study methods of preserving fertility and maintaining satisfactory crop yields on intensive farmed irrigated land by the use of short-term rotations. Sugar beets and potatoes have yielded the highest in a five-year rotation, suggesting that this may be one of the better rotations.

Closely related to rotational work is a crop sequence experiment started in 1947. Seven of the commonly grown crops in southern Alberta are grown after themselves, after the other six crops and after summerfallow. These crops are canning peas, canning corn, potatoes, barley, soft spring wheat, sugar beets, and beans. Field beans, canning peas, and potatoes have been found to be the most suitable preceding crops. Crops following cereal grains or sugar beets yield lower than when they follow the other four crops or summerfallow. These results favor the use of beans and peas, and also potatoes as preceding crops. The merits of potatoes may be attributed in part to the fact that they impart a good structure to the soil. However, potatoes do not yield well when grown after themselves.

Summerfallow is not generally recommended for irrigated land. The two-year results of crops following summerfallow, though favorable, are not striking. Volunteer barley was a serious problem in the spring on most crops succeeding barley. The plots that grew peas had the most weeds on them the following year, while the row crops, corn, and sugar beets left the plots more free from weeds.

Sugar Beet Investigations

Sugar Beet Varieties

Each year promising sugar beet varieties from the United States and Europe are tested for yield of roots, percentage of sucrose, and production of sugar against the three standard varieties for this area. The three commercial varieties that are supplied to growers by the Sugar Company are S.K.E. (selections from a British development), Kuhn (selections from a Dutch importation), and a field hybrid of the two known as "Alberta".

The performance of the three local varieties, which are considered as "tonnage" strains, is very satisfactory. A few of the United States varieties do not stand out because they tend to bolt under local weather conditions. Several European strains have shown much promise and these will be used for further testing.

Dates of Harvesting Sugar Beets

For four of the past five years, there was a significant increase in the total sugar recovered between dates of harvest. During these four years, beets harvested during the last nine days of October produced significantly more sugar than those that were harvested during the first week in October. In 1951 there was no increase in sugar between dates of harvest, because the small yield increases were nullified by the reduction in percentage of sugar. This may be attributed to the severe frosts that prevailed during the last half of October in 1951.

Fertilizer Side-dressing Studies on Sugar Beets

In 1948, 1949, and 1950, in co-operation with the Canadian Sugar Factories Ltd., and the Consolidated Mining and Smelting Co. Ltd., experiments were undertaken to study the effect of applying fertilizer as a side-dressing to sugar beets, in addition to the 100 pounds of ammonium phosphate applied at the time of seeding. Tests were conducted in the beet growing district of southern Alberta on 33 farms during the three years. The sugar beets were side-dressed soon after thinning, with a machine that placed fertilizer at a depth of three inches on both sides of each row. Various fertilizers containing nitrogen were used at different rates of application.

The results from these tests indicate that fields that have been intensively cropped without addition of manure may be expected to be low in nitrogen and probably will react favorably to side-dressed applications of chemical nitrogen fertilizer, in addition to the 100 pounds of 11-48-0 at seeding time. Such side-dressed applications are not so likely to produce increased yields on fields that have been summerfallowed or manured recently. The most effective and profitable rate of application seems to be between 200 and 300 pounds of ammonium sulphate, or ammonium nitrate at a comparable rate of nitrogen. The sugar company fieldmen appear to be able to select, on the basis of crop history, fields that will respond favorably to side-dressing with nitrogen fertilizer.

There was no evidence to indicate that the amounts of fertilizers used and applied early in the season affected the sucrose content of the beets under the conditions of these experiments.

Mechanical Thinning of Sugar Beets

Experiments have been conducted during the last six years to study the effectiveness of thinning sugar beets mechanically. In 1948, three implements were used as pre-thinning treatments, to reduce the number of weeds, mulch the soil, and reduce the stand of beets for subsequent thinning. The finger weeder accomplished all three purposes most effectively, but the operation had to be done when the beets were small. When soil crusting was present, the crusting retarded germination and early seedling growth. The finger weeder has proved to be satisfactory for overcoming this condition. The spike-tooth harrow has been used to advantage for the same purpose on fields that had a good stand but because of its severity it should not be used when the emergence stand is thin.

Recently, down-the-row thinners have been accepted in the United States. These thinners have revolving cutter heads, which can be fitted with various sized thinning knives. In 1952, experimental plots were set up on co-operating farms to compare hand thinning, mechanical thinning, and a combination of the two. The results showed that hand thinning gave an average yield of one ton per acre higher than complete mechanical thinning. Going over the plots once with the mechanical thinner before hand thinning greatly reduced the time required for hand thinning. In addition, these plots in every case gave yields as high as those obtained by hand thinning alone. Twice over with the mechanical thinner followed by hand thinning, while resulting in a further saving of the time involved in thinning, gave lower yields than hand thinning alone. These results indicate that the mechanical thinner can be profitably combined with hand thinning with no decrease in yield. Where labor is not available, the mechanical thinner may be used entirely, but decreased yields may result unless careful attention is paid to the operation of the machine and to the selection of knife heads in relation to stands.

Sugar Beet Harvesting Machinery

The first commercial harvesters were introduced into southern Alberta in 1945. The use of these machines has gradually increased. In the 1952 season about 23 per cent of the beet acreage was harvested mechanically.

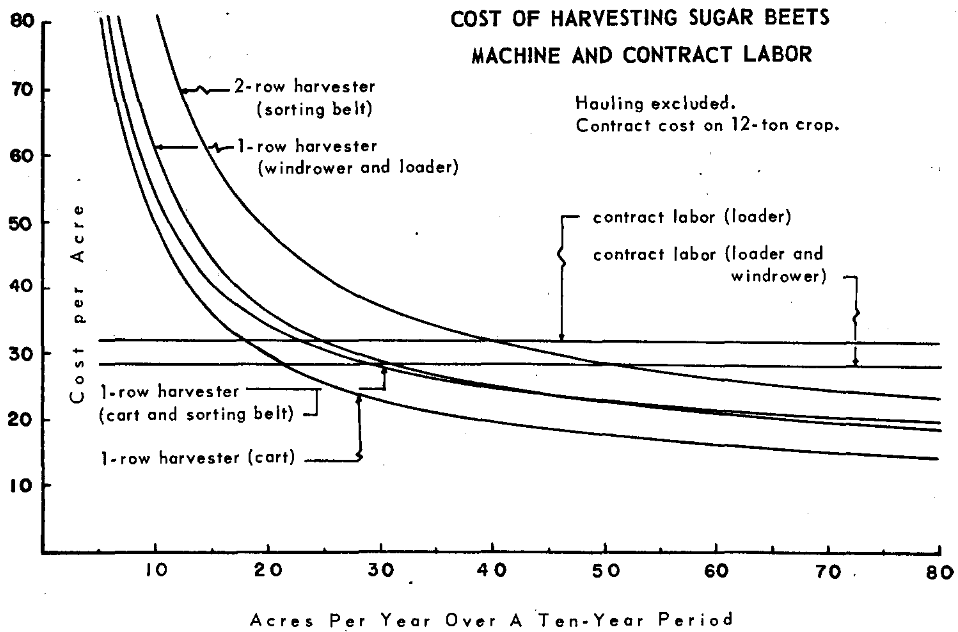
Mechanical topping devices may be classified as ground or "In-Place" toppers and as "Out-of-Place" toppers. Ground or in-place toppers top the beets before they are lifted from the soil. This group may be further subdivided as (*a*) variable-cut units which are mechanically adjusted for thickness of cut and also employ a differential linkage between the gauging unit and the knife or disk and (*b*) fixed-cut of scalper units which employ only mechanical adjustment between the gauging unit and knife or disk. Out-of-place toppers lift the beets from the soil before the tops are removed. These units generally employ the fixed-cut method of adjustment.

Topping efficiency studies show no significant difference between the work of good hand labor (96·3 per cent) and the variable-cut in-place toppers (95·8 per cent). Fixed-cut ground toppers and out-of-place toppers are slightly less efficient. Some loss in efficiency has been found when machines are used on random stands of beets thinned by completely mechanical means. The differences are usually overshadowed by the labor economies involved in mechanical thinning and harvesting.

Adequate separation of beets and soil to reduce the amount of dirt hauled to and from the beet dumps and handled at the factories is a recurring problem. Studies conducted since 1946 have shown that dirt tare has been less, generally, where harvesters and loaders are used than where hand methods of topping and loading are employed. This is true only where a sorting belt or other means of clod elimination such as preharvest irrigation to condition the soil are employed.

Field performance data indicate that single-row ground toppers can be expected to average 2½ acres per day while single-row out-of-place toppers will average four acres per day. The differencee is a result of the usable ground speeds. Multiple-row units can harvest 5·5 acres per day over the season. Performance records for all types have varied considerably. Careful crew organization and the provision of adequate hauling facilities, including the possible use of temporary farm storage are factors in performance. The use of the beet windrows and the use of self unloading storage carts are two temporary storage methods now employed.

Cost studies are summarized in Chart 1. The curves include operating costs such as fuel, oil, repairs, and labor as well as liberal depreciation charges for machinery ownership. The chart indicates that single-row machines should harvest a minimum of about 25 acres and the multi-row units a minimum of 50 acres per season. Optimum economical use over a 10-year period is about 50 and 100 acres, respectively. The average harvesting season in southern Alberta is of four weeks duration. Daily performance records indicate that optimum use can be obtained, although in many cases custom work will be involved.



IRRIGATION INVESTIGATIONS

The expansion of large-scale irrigation within the low-rainfall region of the prairies has created need for further basic data on the use of irrigation water, to ensure maximum returns while maintaining a permanent agriculture under the ditch. Investigations were accordingly initiated in 1949 and four years' results, based mainly on experiments conducted at Taber, Alta., are now available.

In part, these irrigation experiments were designed to determine the consumptive use of water for all field crops grown under irrigation in the region, and particularly the amounts of water, including irrigation and rainfall, required for maximum yield and quality under varying levels of fertility. The outline of these studies is broad in scope, since the consumptive use of water is affected by a wide range of conditions and interrelated factors, including climatic variations, soil type, fertility, time and depth of irrigation, and variations in the moisture needs of individual crops.

Consumptive use is defined as the total water needed to produce a crop, and includes moisture used in building plant tissue, stored in the mature plant, transpired through the leaves, and moisture lost by evaporation directly from the ground surface of the crop area. It does not include water lost by percolation below the root zone or wasted through surface runoff. These are additional losses that must be provided for in calculating total farm use.

Maximum yields of such crops as corn, tomatoes, and potatoes have been obtained usually with consumptive uses varying from 12 to 15 inches. The cereal grains and sugar beets used up to 18 inches whereas grasses required nearly 20 inches. Alfalfa used up to 22 inches to produce highest yields. Consumptive use was greatest during the seasons of lower precipitation and relatively higher temperatures.

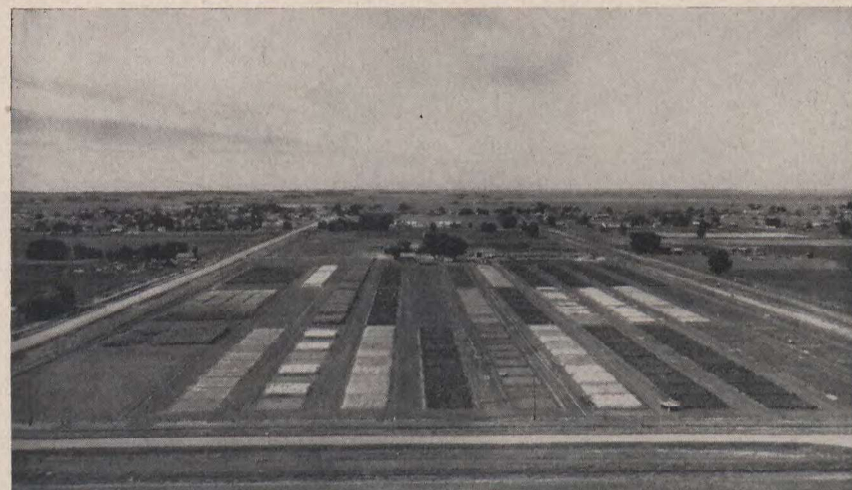


FIG. 3—Aerial view of the Taber Irrigation Experiment Substation.

During the four years, 1949 to 1952, the overall consumptive use of water required for maximum yields of 16 crops, grown under the tests at the Taber Substation averaged 16·2 inches. One-quarter of all of the crops produced maximum yields with less than 14·1 inches, and one-quarter used more than 18·6 inches, while one-half of the crops used from 14·1 to 18·6 inches to produce maximum yields. The tests need to be continued over a longer period, but results so far indicate an overall consumptive use of nearly 19 inches.

The rainfall during the growing season at Taber averages around nine inches and on the basis of an overall consumptive use of 19 inches for all crops, the average irrigation requirement would amount to about 10 inches. To supply this amount of water from the legal duty of 18 acre-inches per acre would require a water application efficiency of more than 50 per cent, which is probably much higher than that being obtained on most irrigated farms in the area.

Quality, as well as yield, was affected greatly by water use. However, maximum, or near maximum, quality of crops grown was obtained for the most part with consumptive uses giving maximum yields per acre, and particularly where higher levels of fertility prevailed. Most crops showed decreased protein contents with increased water use, while phosphorus contents were either maintained or increased with added use of water .

The sugar content of beets and purity of sugar beet juice were not affected greatly by increased water use, but the sugar content of canning peas was decreased by added water, and the yield of ripe tomatoes was reduced sharply by excess moisture. Cucumbers required light, frequent irrigations for maximum yield and quality.

Studies with sprinkler irrigation carried on from the Lethbridge Station indicate that this method of applying water may be most useful in this region as a supplement to surface irrigation for watering higher-priced crops and for irrigating lands not suited to surface irrigation, where economic conditions permit.

Sprinkler irrigation affords a high degree of moisture control over a wide range of soil types and topography. This can be accomplished without the aid of skilled irrigators if wind velocities are not excessive or too changeable. The

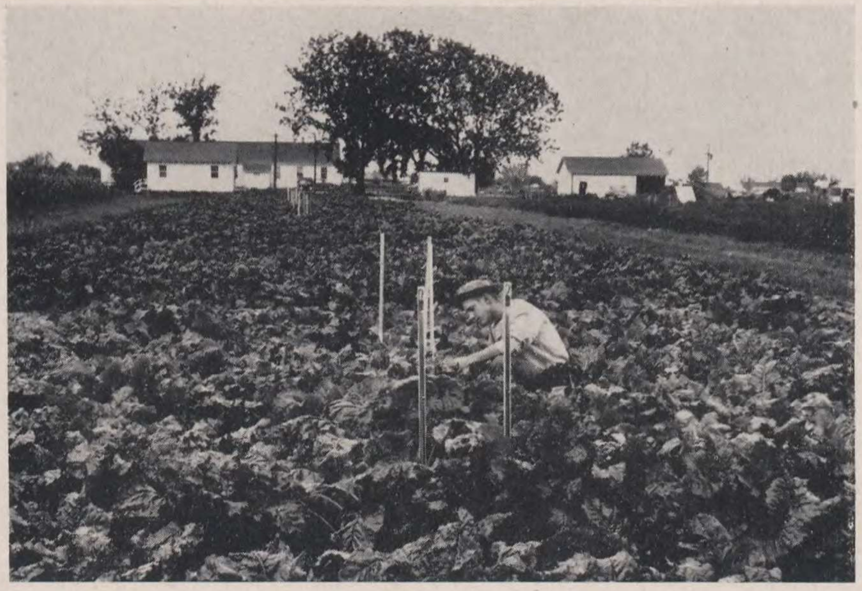


FIG. 4—Soil moisture tensiometers installed on sugar beet plots at the Taber Substation to determine when irrigation water should be applied.

main disadvantages of sprinkler irrigation for prairie conditions are high initial cost, high operating costs, wind interference, and the aversion of skilled irrigators to carrying pipe through muddy fields and wet foliage.

The economic feasibility of establishing irrigation farming wholly on the basis of sprinkler irrigation under prairie conditions has yet to be determined, except where crops of sufficiently high value per acre are grown.

CEREALS

During the last six years the work on cereal crops at Lethbridge has been expanded and intensified. A Cereal Breeding Laboratory has been established for the purpose of research in the field of cereal plant breeding. A highly trained staff has been brought together to plan and carry out breeding programs and fundamental research concerned with hard red spring wheat, hard red winter wheat, soft white spring wheat, rye, oats, barley, flax, field peas and beans, safflowers, and other crops. The bringing together of specialists and the provision of facilities for testing and research have already resulted in the initiation of new projects and the revision and intensification of the older established ones. These changes are being brought about for the purpose of giving better service, on a regional basis, to farmers in the western grain-growing areas.

Hard Red Spring Wheat

New Varieties

The licensing of the variety Chinook marks further progress in the development of sawfly- and drought-resistant hybrids for the drier areas of Alberta and Saskatchewan. This sawfly-resistant variety was produced by the Project Group on Breeding Spring Wheats for the Prairie Region.

The new variety Chinook possesses milling and baking quality equal to that of Marquis, thus making it eligible for top market grades. Under drought conditions Chinook produces a higher bushel weight than either Thatcher or Rescue. In southern Alberta the yield of Chinook is slightly above that of Rescue and slightly below that of Thatcher. The high degree of sawfly resistance, good milling and baking quality, and ability to produce a high weight per bushel under dry conditions, should make Chinook a valuable variety for southern Alberta and southwestern Saskatchewan.

Breeding Program

The characters that are of major concern in the breeding program at present are sawfly resistance, yield, and quality. Breeding for disease resistance is also of considerable importance. The most important phase of the breeding work is the development and selection of hybrids possessing a high degree of sawfly resistance. Studies have shown that a high positive correlation exists between the solid-stemmed condition and sawfly resistance. Because the type of resistance currently being used in bread wheats, *Triticum aestivum,* occasionally tends to break down under unfavorable environmental conditions, and because the *T. durum* type of resistance cannot readily be transferred to *T. aestivum* hybrids, efforts are being made to add the resistance of *Agropyron elongatum* (tall wheat grass) to bread wheat hybrids. Two other solid-stemmed grasses, *A. intermedium* and *A. glaucum,* are being crossed with *T. aestivum.*

Recently a backcrossing program was initiated to transfer sawfly resistance from solid-stemmed types to high-yielding, good quality, sawfly-susceptible varieties, e.g. Thatcher. By backcrossing it should be possible to obtain a variety having the resistance of one parent plus all the desirable characters of the other.

Fundamental Studies

The nature of wheatstem sawfly resistance is being studied through artificial transfer of eggs and larvae from one host to another. It was concluded that resistance could be attributed partly to lowered egg hatchability in the solid-stemmed varieties. The stage of development of the stem also materially affects hatchability.

The relationship between wheat stub diameters and sex of the emerging sawflies, which can apparently cause a shift in the sex-ratio of the sawfly population, is under study.

Another phase of the research program is concerned with the association between the degree of root rot infection, yield, and other agronomic characters.

Varietal Testing

The testing of new varieties and hybrids is carried out in co-operation with the Illustration Stations Division. Thatcher and Rescue are the leading varieties in this area. Thatcher is high yielding but lacks sawfly resistance and produces a low bushel weight when drought conditions prevail. Rescue is grown in areas where sawflies are a problem. One of the chief disadvantages of Rescue is that it is not eligible for grades above No. 3 Manitoba Northern. Chinook is sawfly-resistant, produces a high bushel weight under dry conditions, and is eligible for top grades. This variety will give its best performance on the brown soils. Agronomic data on these three varieties are presented in Table 4.

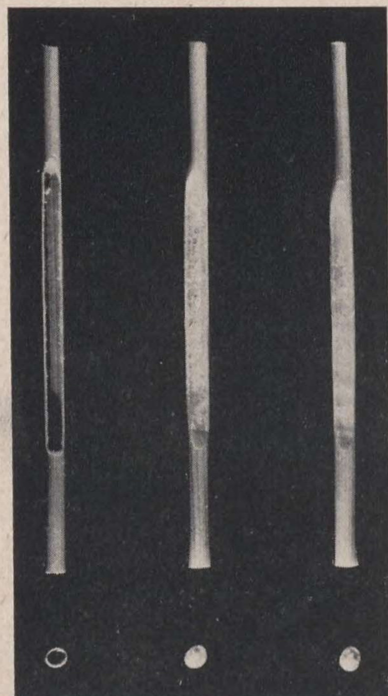


FIG. 5—Sawfly-resistant varieties. *Left:* Longitudinal and cross sections of hollow-stemmed, sawfly-susceptible variety Thatcher (left) and solid-stemmed sawfly-resistant varieties Rescue (centre) and Chinook (right). *Lower:* Sawfly-resistant hybrids are standing erect while sawfly-susceptible hybrids have been almost completely cut. (Photo from co-operating station at Regina.)

TABLE 4.—AGRONOMIC DATA FOR HARD RED SPRING WHEAT—DRY LAND

Variety	Zone 1		Zone 2A				
	Yield[1] (bus. per acre)	Bu.[1] weight (lb.)	Yield[2] (bu. per acre)	Days to mature	Height (inches)	Lodging[3] resistance (1–9)	Sawfly damage (%)
Thatcher......	21·6	57·7	32·1	104·3	38·0	1·5	35·3
Rescue........	19·4	59·3	30·5	103·4	38·0	1·9	2·9
Chinook.......	20·1	60·7	29·4	104·3	39·6	1·9	6·5

[1] Average of 27 tests conducted at several stations for 6 years.
[2] Average of 14 tests.
[3] Lodging resistance: 1 erect, 9 prostrate.

Saunders is grown to some extent on the black soils of the foothills area where it yields well and where its earliness reduces the hazard of fall frosts.

Soft White Spring Wheat

Irrigated Land

Soft white spring wheat is one of the few important crops grown successfully on irrigated land in southern Alberta. Approximately 30,000 acres were grown under contract for several milling companies in 1952. With the expansion of irrigation, production of soft wheats is likely to become very important since it is better suited to the climatic conditions of this area than most irrigated crops.

Lemhi, a wheat produced in the United States, is most commonly grown here. It is a high yielder with good soft-wheat quality but it is not entirely satisfactory to the biscuit trade. The protein content is a little high for best results. It is moderately late-maturing, and is susceptible to leaf and stem rust and mildew. A comparison of Lemhi with Thatcher for a three-year period is presented in Table 5. The protein content of Thatcher is much too high for satisfactory pastry flour.

TABLE 5.—AGRONOMIC DATA FOR SOFT WHITE SPRING WHEAT—IRRIGATED LAND

Variety	Yield Bu./Acre	Bu. Wt. lb.	Height inches	Days to mature	Lodging[1] resistance	Protein %
Lemhi....................	66·9	61·8	42	119	5	11·3
Thatcher..................	64·4	63·3	40	116	5	14·5
Idaed.....................	61·9	61·5	37	113	4	12·4

[1] One year results only (1 erect, 9 prostrate).

An extensive breeding program with soft white wheat was started in 1940. The objective is to produce a variety that is high yielding, resistant to leaf and stem rust, and of the desired quality. Several varieties from Australia and the United States showing resistance to leaf and stem rust have been used in a crossing program. The hybrids are tested for leaf rust at Creston, B.C., where natural rust epidemics occur every year. A number of hybrids appear to have high resistance to leaf and stem rust. A backcrossing program may be necessary to obtain a hybrid with satisfactory quality.

Winter Wheat

Dry Land

Winter wheat is generally grown successfully in southwestern Alberta as far north as Vulcan and as far east as Taber and Foremost. Beyond this area it is grown to some extent but often may be severely damaged by winter-killing. In recent years there has been increasing interest in this crop for dry land production because it allows for better distribution of farm labor, provides ground cover against winter wind erosion and, if not damaged severely by winterkilling, will usually outyield spring wheat. Increased acreage and more successful production of winter wheat will depend on the development of better adapted varieties and an increased knowledge of appropriate cultural practices.

In 1952, fields of winter wheat severely damaged by streak mosaic were observed. This disease probably has been present in the area in previous years, but was not identified. Observations indicated that severe infection was associated with seeding early in August. Losses may be reduced by delaying seeding until September first. This is also the recommendation for reducing losses due to root rot. Preliminary investigations into the possibility of developing resistant varieties indicate resistance only in *Agropyron* sp. and Wheat × *Agropyron* derivatives.

Evidence from winter wheat variety trials indicates a considerable differential effect of soil packing on winter survival and yield. In one test in 1952, the average yields of thirteen varieties from rows packed prior to seeding and those not packed were 25·8 and 12·5 bushels per acre, respectively. These differences in yield appeared to be largely due to differences in winter survival.

A large number of winter wheat varieties have been introduced and tested by the Lethbridge Station. The best varieties available to date are Kharkov M.C. 22 and Yogo. They are the only varieties with sufficient winter hardiness for Alberta conditions. Kharkov M.C. 22 is superior to Yogo in strength of straw but is more susceptible to shattering. Yogo has some bunt resistance but Kharkov is completely susceptible.

In 1949 an intensive breeding program was started at Lethbridge to develop by hybridization new improved varieties of winter wheat adapted to dry and irrigated land in Alberta. The desirable characters to be combined in a new variety are increased winter hardiness, resistance to sawfly and smut, increased resistance to lodging and shattering, improved quality, and higher yield. Since the start of the program a large number of crosses have been made and intensive selection among the hybrid populations is being carried out. In this breeding program investigations also are being made into the possibility of transferring such desirable characters as additional winter hardiness from certain grasses to winter wheat.

Irrigated Land

Tests of soft winter wheats on irrigated land have revealed no variety suitable for commercial production. In the breeding program some attention is being given to the development of soft winter wheats for irrigated land. Such varieties should have more winter hardiness than varieties available at present as well as strong straw, resistance to leaf rust and smut, good yield, and quality. A number of hybrids with very high yielding ability, stiff straw, excellent bunt resistance and soft wheat quality have been obtained from plant breeders in the State of Washington. Although not sufficiently hardy for Alberta, they are excellent parental material for crosses with more hardy varieties.

Winter Rye

Dry Land

A winter rye breeding and testing program is being carried on at Lethbridge. Dakold is the variety generally recommended for Alberta and is the only variety eligible for registration by the Canadian Seed Growers' Association. The variety Petkus has out-yielded Dakold in one trial but has not been adequately tested as yet. Antelope, a selection recently named by the University of Saskatchewan, is now being tested at Lethbridge. In the one year in which it was tested it did not yield so well as Dakold, although it has out-yielded that variety in Saskatchewan.

A strain of tetraploid rye developed in Germany is now being tested at the Lethbridge Station but its value as a large-seeded high-yielder remains to be proved.

Barley

Dry Land

During recent years barley has become a competitor with wheat as a cash crop on dry land in southern Alberta. Although several factors have contributed to this situation, one of the most important has been the general use of higher-yielding, better-adapted barley varieties. In 1949, Compana, an American variety, was licensed in Canada through the efforts of the Cereal Breeding Laboratory at Lethbridge, and Foundation Stock is now available for distribution to seed growers. It is a semi-smooth-awned, two-rowed feed barley, and possesses a high degree of drought resistance. It is an excellent variety for straight combining.

Vantage barley was introduced into southern Alberta during the last six years and is now being grown rather extensively. Vantage is a smooth-awned, six-rowed barley with high-yielding potential and wide adaptability.

The average results obtained over a four-year period for five varieties grown on dry land at Lethbridge are shown in Table 6.

TABLE 6.—VARIETY TEST OF BARLEY—DRY LAND. 1949-1952

Variety	Days to mature	Height in inches	Bushel weight in pounds	Yield bushel per acre
Vantage	103·7	31·6	54·4	54·8
Compana	101·2	25·4	55·0	54·4
Montcalm	102·6	35·8	55·6	50·7
Newal	101·1	33·3	54·5	47·4
Titan	99·9	30·4	54·5	44·2

In addition to the breeding and testing program, fundamental research concerned with the inheritance of resistance to the various smut diseases is in progress.

Irrigated Land

For the irrigated areas quality feed barleys with resistance to lodging, shattering, and the smuts are essential. A new variety, Harlan, was licensed in 1951. It is intended for production on the irrigated areas of southern Alberta. It is a six-rowed, rough-awned feed barley and is not acceptable for malting. Its high yield, wide adaptability, and resistance to lodging should enable it to replace the old variety, Trebi. The average results from five varieties grown on irrigated land at Lethbridge over a three-year period are given in Table 7.

TABLE 7.—VARIETY TEST OF BARLEY—IRRIGATED LAND, 1949-1951

Variety	Days[1] to mature	Height[1] in inches	Strength[2] of straw	Bushel weight in pounds	Yield bushel per acre
Harlan	99·2	36·2	3·2	53·0	75·5
Titan	95·5	36·7	2·7	59·2	65·2
Montcalm	96·3	43·8	5·5	55·3	56·0
Trebi	98·3	34·2	7·5	53·5	64·9
Newal	94·9	39·8	4·0	53·3	54·3

[1] Average for 1949 and 1950.
[2] Data for 1951 (1 erect, 9 prostrate).

The production of malting barley in the irrigated areas is a possibility that should not be overlooked. Agronomically, Harlan is a satisfactory variety for these areas, but it is not a malting barley. Both six-rowed and two-rowed varieties are being tested at this time to determine their malting qualities when grown on irrigated land.

Oats

The varietal picture for oats in southern Alberta has not changed markedly over many years. Rust has seldom been important in this area. Therefore, the old variety Victory has long retained a high degree of popularity. Recently newer varieties such as Ajax, Eagle, and Exeter have begun to replace Victory. Work with oats has not been stressed at the Lethbridge Station. The main emphasis for this crop has been directed towards varietal testing, as exemplified by the Co-operative Oat Test and the varietal trials grown in conjunction with the Illustration Stations Division. Eagle has replaced Victory as the recommended oat variety for the irrigated areas. Eagle is characterized by high yielding ability, lodging resistance, and an attractive seed sample. It is fairly late in maturity and susceptible to smut.

Flax

The Lethbridge Station has compared flax varieties in yield tests over many years. At the present time the varieties recommended are Royal, Redwing, and Dakota. Royal is late in maturity and does not ripen uniformly. It is moderately resistant to wilt and to some races of rust. It is grown in the southeast portion of Alberta. Redwing is lower than Royal in yielding ability and is susceptible to rust. Its early maturity and lodging resistance make it popular in the Foothills region. Dakota was licensed in 1947. It is a good yielder, medium early, uniform in ripening, and resistant to wilt and some races of rust. The relatively new varieties Rocket, Redwood, and Marine have not been tested sufficiently to indicate definitely their place in Alberta agriculture. The variety Dakota is recommended for the irrigated areas of southern Alberta.

Field Beans

Irrigated Land

There is a definite need for more cultivated crops on irrigated land. Continuous grain production brings about weed problems and too low monetary returns under conditions where overhead costs are high. Any cultivated crop, therefore, that helps to defeat the weed problem, and at the same time returns a better profit than grain, should be a valuable one for southern Alberta. Field beans are a promising crop of this class.

Since practically all the beans used in the Western Provinces are now being imported, and freight rates have increased considerably in recent years, there is an excellent local demand. The cost of imported beans is about $10.00 per cwt. f.o.b. Lethbridge. Bean crops should be expected to yield from 1,000 to 1,500 pounds per acre. This return, plus the fact that an increased yield can be expected from the following crop, should make field beans an attractive crop.

Burbank and Great Northern No. 5 are the two varieties that are being recommended for the district. At the Lethbridge Station, on irrigated land Great Northern No. 5 has given an average yield for a four-year period of 51·8 bushels per acre and has ripened in 102 days. Burbank has yielded 41·2 bushels and ripened in 99 days.

Foundation seed of these two varieties is now being produced by the Lethbridge Station. Registered seed of Burbank has been produced for several years and is also now being produced in the case of Great Northern No. 5. Co-operative work has also been conducted with farmers in the production of certified seed, in an effort to build up a supply of pure seed of these two varieties for commercial production.

Field Peas

Irrigated Land

Variety tests of peas have been conducted annually under irrigation at the Lethbridge Station. Early Blue and Chancellor, two of the best varieties for seed production, have given a five-year average yield of 26·0 and 27·8 bushels per acre respectively. Chancellor produces a heavy vine growth and is one of the best varieties to grow for hay purposes. Bluebell, Green Wrinkled, and Idabell are three varieties that produce seed that is either blue or green in color. These three are suitable varieties for the boiling trade, and each has averaged 27·5 bushels per acre over a five-year period.

A small quantity of registered seed of the Early Blue variety is being produced annually at the Station, as well as a little commercial seed of Green Wrinkled and Chancellor.

Safflowers

Although safflowers have been tested at Lethbridge for more than a decade they have not been looked upon until recent years as having much possibility of becoming a commercial crop for southern Alberta. The varieties tested formerly were late maturing and too low in oil content. Superior strains recently developed by the Chemurgy Department of the Nebraska Experiment Station have resulted in the crop becoming one of commercial importance in the northern States within the short period of only one or two seasons.

The Nebraska Experiment Station has been conducting a co-operative test of safflower varieties at 20 different points. Three of these points; namely, Lethbridge, Alta., Altona, Man., and Ottawa, Ont., are in Canada while the remainder are in the northern States. In 1951 weather conditions were probably the worst ever experienced in southern Alberta for late-maturing crops and all safflower varieties failed to mature at Lethbridge but in 1950, which might be considered close to a normal season for southern Alberta, the results obtained at Lethbridge compared very favorably with average results for the 20 tests conducted. The average yield of seed for nine varieties at Lethbridge was 1,067 pounds per acre, with an average oil content of 27·1 per cent, as compared with the corresponding averages for the 20 tests of 873 pounds of seed per acre and 28·4 per cent oil. These figures are for the test conducted on dry land.

Safflowers have also been tested annually under irrigation. They can be grown economically on farms where sugar beets are grown, since sugar beet drills and cultivators can be used for handling them and the harvesting can be done by straight combining. However, early seeding is important for safflowers and it is therefore advisable to choose irrigated land that can be prepared early in the spring.

Agronomic data for a few of the better varieties tested in 1950 are compared with Dakota flax in Table 8.

TABLE 8.—VARIETY TEST OF SAFFLOWERS—IRRIGATED AND DRY LAND, 1950

Variety	Irrigated land				Dry land			
	Yield per acre	Oil content	Iodine number	Height	Yield per acre	Oil content	Iodine number	Height
	lb.	%		in.	lb.	%		in.
N. 3	764	16·8	147	33	1,210	24·8	149	28
N. 8	495	27·9	148	32	904	29·2	148	24
N. 852	149	19·4	144	21	1,282	31·4	146	27
Indian	767	11·6	144	29	884	24·6	147	24
Dakota Flax	1,107	38·4	188	—	547	39·5	192	24

HORTICULTURE

During the past six years the horticultural research program has been greatly expanded to meet the needs of the vegetable canning industry of irrigated southern Alberta. In 1951 a food processing laboratory was completed and equipped. This laboratory has equipment and facilities with which it is now possible to investigate the nutritional value of vegetables grown in

FIG. 6—The main processing room of the Food Processing Laboratory, with the pilot canning plant dominating the forepart of the picture. The technician is operating a semi-automatic can sealer. Steam can be seen rising from the steam exhaust box to his left.

southern Alberta, as well as the processing characteristics of the many varieties of horticultural plants and their products. A variety testing project, covering the different vegetable cropping areas of southern Alberta, was started in 1950. These locations are in the Magrath-Raymond area and the Big Bend area north of Taber. These plot areas are studied in conjunction with the older established horticultural plot areas at Lethbridge and Taber. To the above mentioned expanded facilities and plot area, have been added many of the latest experimental plot recording instruments and apparatus, as well as good field equipment with which to maintain the plots.

Tomato Breeding and Selection

The major contribution of the horticultural section during the past six years has been the introduction and naming of the Earlinorth and Early Lethbridge tomatoes. Earlinorth is an early maturing, self-pruning tomato, well adapted to areas where normal home garden tomato production is either difficult or impossible. This tomato is capable of reaching maturity under cool, adverse conditions. It will produce ripe fruit where it was formerly thought impossible to grow tomatoes. In 1952 seed distribution was undertaken by a prairie seed company.

Early Lethbridge, while an early determinate tomato variety, is much larger and smoother than Earlinorth. It is somewhat later maturing, but is an excellent yielder of high quality fruit considered acceptable for processing purposes. This variety is still being distributed by the Lethbridge Experimental Station.

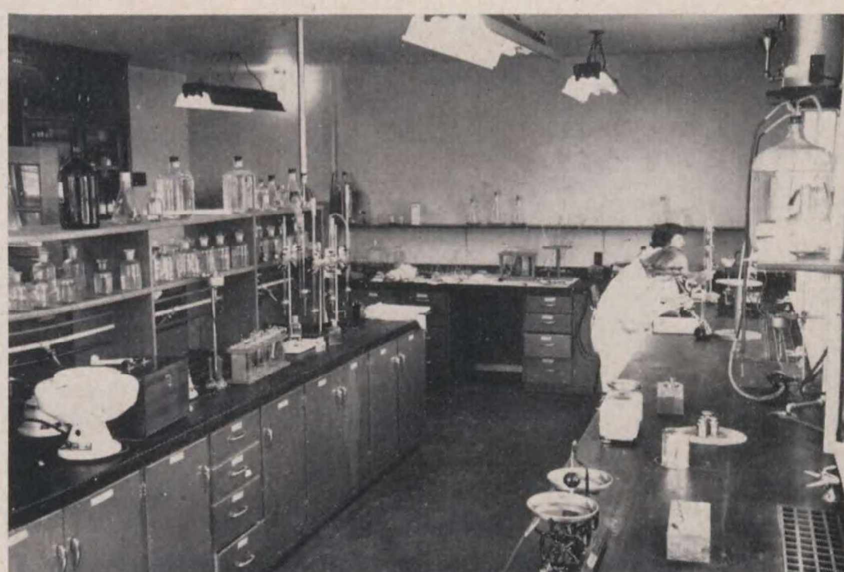


FIG. 7—The food chemistry laboratory, showing general arrangement and some of the equipment used. The technician closest to the camera is using a refractometer to determine sugar content of tomatoes.

Data over several years indicate that Earlinorth and Early Lethbridge produce ripe fruit more readily than the standard varieties and Early Lethbridge is of better quality for processing. Table 9 shows comparative yields of ripe tomatoes harvested during the periods 1948-52.

TABLE 9.—COMPARATIVE YIELDS OF RIPE FRUIT AND FIRST DATE OF RIPE FRUIT, EARLINORTH, EARLY LETHBRIDGE AND TWO STANDARD TOMATO VARIETIES, 1948-1952

Variety	1952 yield per 11 plants	1948-50 ave. yield per 11 plants	1948-52 ave. yield per 11 plants	Average date first ripe fruits	Yield per acre
	lb.	lb.	lb.		lb.
Earlinorth	41·1	15·2	28·1	17/8	12,342
Early Lethbridge	27·8	8·6	18·4	2/9	7,083
Early Chatham	33·4	6·4	19·9	4/9	8·712
Bounty	8·5	3·6	6·1	8/9	2,662

In an effort to further the development of early maturing tomatoes, extensive study has recently been undertaken to determine if frost tolerance exists in the various tomato species. To date there are some encouraging signs in this direction. Should frost tolerance be established, it will mean that tomato plants can be transplanted in the field earlier than is at present considered to be good management. This will mean earlier and higher yields of ripe fruit.

Weather and Tomato Production.—Tomato production is dependent upon ample heat and sunlight. A study of the mean daily temperatures at Lethbridge and Taber reveals that Taber, which is located 30 miles east of Lethbridge, has a mean temperature 2°F. higher than Lethbridge. This warmer temperature produces earlier and heavier yields of tomatoes.

The length of the frost-free period is important. For tomato production, spring temperatures below 31°F. and fall temperatures below 29°F. are the known limits of frost tolerance. The earlier tomato plants can be placed in the field in the spring, barring frosts, the heavier the yields. During the past 50 years the temperature data at Lethbridge show that only slight chances are taken by planting tomatoes after May 24. If earlier planting is desired, protection by means of hotkaps or hot tents is necessary. In the fall, after September 9 and up to September 23, frosts are common. Between these dates there is a 50-50 chance of harvesting late tomatoes. After September 23 the chances of harvesting ripe tomatoes are greatly reduced.

Dates of Seeding and Transplanting Tomatoes.—In 1950 and 1952 two tomato varieties, Early Chatham and L-3700 Sel. 3 (Early Lethbridge), were seeded at 10-day intervals from March 24 to April 23 and were transplanted to the field at five-day intervals from May 26 to June 10. In 1950 no yield differences could be attributed to differences in seeding dates. In 1952, however, seeding on April 13 resulted in significantly higher yields. Maturity was slightly earlier for the earliest dates of seeding and transplanting, while no differences in fruit size or quality were observed between treatments. Results of this experiment to date indicate that better yields are obtained from well grown, sturdy plants set out as early as possible.

Cultural Studies with Tomatoes.—Indications are as follows:

1. Use of defoliants such as cyanamides in the fall would appear to have some merit.
2. Artificial light covering the full range of the spectrum does not seem to increase ascorbic acid in ripening tomatoes after harvest.

3. Increase in growing space in flats results in increased yields of ripe tomatoes. The economical use of space is a determining factor in spacing of plants in flats.
4. Plant bands used to produce more vigorous plants show increase in yield of ripe tomatoes with increasing size of band. The undissolving type was found to be slightly superior to the dissolving type.
5. The effectiveness of "Hot Tents" or paper cloches to protect against a slight frost is still undetermined. The use of these cloches did serve to materially increase early yields.

Wind Influence on Vegetable Production

During 1951 and 1952, the effects of prevailing westerly winds upon vegetable production in southern Alberta were observed. The four plot areas used in the District Vegetable Trials possess varying degrees of wind protection, as well as differences in soil type. At Lethbridge the plots are located on heavy silt soil within a sheltered area. At Taber the soil is a loam with fair wind protection. At Magrath-Raymond heavy silty clay predominates with only slight protection, and in the Big Bend sandy loam soils predominate and no protection exists.

It was observed in 1951 and again in 1952 in the Big Bend that wind damage could almost eliminate row crops with certain crops more seriously affected than others. In 1952, of seven tomato varieties, five did not mature in the Big Bend and one did not mature at Magrath-Raymond. Yield data showed that the highest mean tomato yield—37·1 pounds per 30-foot row—was recorded in the most protected area (Lethbridge) and decreased with decreasing amounts of protection to a low of 0·5 pound in the Big Bend. Cauliflower matured later and yielded less in the Big Bend than at Lethbridge, while snap beans matured later at Lethbridge with no difference in yields.

It has been generally accepted that light soils, being warmer than heavier soils, foster more rapid growth, earlier maturity, and higher yields of most vegetable crops. The lighter soil in the Big Bend, however, appeared to have the opposite effect even though moisture was not a limiting factor during the seasons in question. It is suggested that the reduction in yield and lateness of maturity is due to physical damage, combined with a cooling effect, caused by the winds. A comprehensive study is being initiated so that proper material and layout for field shelters can be recommended.

Maturity Studies of Vegetables for Processing

During the canning seasons of 1951 and 1952, samples of peas were selected at a district cannery on the basis of tenderometer reading. These samples were graded according to sieve size. Tenderometer and texturemeter readings, penetrometer readings, and corn tester readings were taken of subsamples of each size group. In the laboratory a portion of each raw sample was analysed for starch, ascorbic acid, and total soluble solids, while the remainder of each was canned and later analysed for alcohol-insoluble solids and appraised for flavor and texture by taste panels.

The results indicated that either the tenderometer or the texturemeter could be used to obtain a reliable evaluation of maturity while the penetrometer and corn tester readings were only fair. Of the chemical tests, only the alcohol-insoluble solids appeared to closely correlate with maturity. The starch content, total soluble solids, and ascorbic acid content were not considered reliable.

The texturemeter, because of its mobility, is considered to be a valuable instrument for canning company fieldmen to evaluate maturity in the field.

Sweet Corn Germination Experiment

In 1950 and 1951, the seed of four sweet corn varieties was exposed in three different media to temperatures of 5°, 10°, and 15°C. for varying periods of time. It was observed that germination was markedly reduced by temperatures of 10°C. or lower, and reduced further as the duration of exposure to these temperatures was increased. Germination was more complete in vermiculite than in soils, possibly due to better aeration and lack of disease organisms. All varieties in the trials reacted similarly to temperature.

On the basis of these results, it is recommended that for maximum germination sweet corn should not be sown until mean soil temperatures are above 10°C. (50°F.). Seed treatment is considered beneficial in increasing germination.

Strawberry Growing

The effects of different rates of irrigation and mulching and of the number of years of cropping upon yield and the incidence of chlorosis have been studied over the last six years using British Sovereign strawberries. The results indicate that irrigation improved yield and quality of the fruit and that frequent light irrigations appeared to be more effective than fewer heavy irrigations. In most years, mulched plots yielded less fruit than those that were not mulched, but in seasons of late spring frosts mulching was beneficial. The third and fourth years of cropping resulted in heaviest yields. The incidence of chlorosis did not vary noticeably between treatments and did not appear to affect yields to any marked degree.

FORAGE CROPS

The work of the Forage Crop Section deals mainly with the improvement and production of forage crops on both dry and irrigated land and with range research and improvement of native range lands. The crop improvement is largely concerned with breeding disease-resistant alfalfa, winter-hardy orchard grass and other high-yielding grasses and legumes suited for both hay and pasture purposes. Range land research deals with effects of overgrazing on vegetative cover, carrying capacity, and erosion control. Revegetation studies are also conducted in both the foothill range land and abandoned wheat land of southeastern Alberta.

Alfalfa Varieties

Alfalfa is the most important forage crop grown under irrigation. It is used for hay, for the manufacture of alfalfa meal, and to some extent for pasture and improvement of soil fertility. It provides two very good cuttings yearly with the total yield of cured hay ranging from 2 tons to 4·3 tons per acre.

Bacterial wilt is the major problem in alfalfa production in the area. This disease causes extensive reduction of stand after the second crop year with a decided yield loss as the age increases. The effects of this disease on different varieties is indicated in Table 10 which reports the yields of ten varieties for six years on irrigated land. Bacterial wilt infection became evident in the second year and yield reductions were recorded in the third year.

Yield reductions are most noticeable in varieties Grimm, Ferax, Canauto, Rhizoma, and Viking. Ladak, Cossack, and Buffalo show reduction during the last two years while Ranger and Hardistan maintained fairly consistent yields throughout.

TABLE 10.—YIELDS OF 10 VARIETIES OF ALFALFA FOR 6 YEARS UNDER IRRIGATION

(Tons per acre 12% moisture—4 replications)

Variety	1946	1947	1948	1949	1950	1951	6-year average
Ladak	5·97	4·80	5·35	4·12	3·83	2·32	4·40
Ranger	5·39	4·60	5·05	4·39	3·92	3·06	4·40
Grimm	5·85	4·64	3·72	1·83	1·42	0·59	3·00
Buffalo	4·86	4·08	4·78	3·76	3·46	2·30	3·87
Hardistan	5·16	4·34	5·01	4·48	4·64	3·48	4·51
Rhizoma	5·67	4·30	3·73	2·37	1·43	0·68	3·03
Cossack	5·27	4·86	5·47	4·42	3·60	2·49	4·36
Canauto	5·06	4·13	2·66	0·58	0·34	0·20	2·16
Viking	5·60	4·48	4·87	3·91	3·08	1·43	3·89
Ferax	5·34	4·47	3·14	1·18	0·96	0·42	2·58

Only two varieties were affected by winter injury. Ranger was damaged on two occasions, but survived sufficiently to produce fair yields. Buffalo was reduced in stand by winterkilling, particularly during 1950-51.

The severity of bacterial wilt is more clearly evident in a second variety test seeded in 1950. The year 1951 was cool and wet, ideal for the increase and spread of this disease. During the winter of 1951-52 there was considerable winterkilling. As a result of these two factors yield and stand reductions were extreme by the second crop year.

TABLE 11.—YIELDS OF 10 ALFALFA VARIETIES FOR 2 YEARS UNDER IRRIGATION AT LETHBRIDGE

(Tons per acre 12 per cent moisture—4 replications)

Variety	1951	1952	Yield reduction
Ladak	4·77	2·72	2·05
Viking	4·42	2·60	1·82
Grimm	5·14	1·28	3·86
Buffalo	4·29	2·84	1·45
Ranger	4·61	3·58	1·03
Hardistan	4·41	4·36	0·05
Wisc. Syn. C	4·80	4·66	0·14
Hardigan	4·86	2·38	2·48
Cossack	4·87	2·93	1·94
Orestan	4·13	2·85	1·28

The reduction of Grimm, Ladak, Viking, Hardigan, Cossack, and Orestan is due almost entirely to bacterial wilt. The reduction of Ranger and Buffalo is due largely to winterkilling.

Until 1952, wilt-susceptible varieties were considered suitable for short rotations lasting up to four years. The severe reductions in the second year emphasize the urgency of developing a wilt-resistant, hardy variety for these conditions. Ladak is the recommended variety at the present time.

Breeding Alfalfa for Resistance to Bacterial Wilt

A co-operative project between the Lethbridge Experimental Station and the Dominion Plant Pathology Laboratory at Edmonton and the Dominion Forage Crops Laboratory at Saskatoon was begun in 1945 to develop an alfalfa variety resistant to bacterial wilt and crown rot. The multiplication and propagation of selected wilt-free plants was carried out at Edmonton and Saskatoon while the actual testing of the plants for tolerance to bacterial wilt was carried out at Lethbridge.

Over the past six years approximately 2,025 alfalfa lines comprising a total of 48,000 plants have been tested for wilt resistance at this Station. Thirty-one per cent of these originated from wilt-free plants in old infested fields in the Lethbridge area. Forty-one per cent came from the laboratories at Edmonton and Saskatoon. These plants were made up, for the most part, of breeding stocks and crown-rot-resistant material. The remaining 20 per cent came from other Stations and laboratories that wished to have bacterial-wilt-resistance ratings on their breeding material.

Of the Lethbridge lines, 165 proved to be wilt free when exposed to controlled epidemics of bacterial wilt. These 165 lines were placed in a polycross nursery here during 1949 and 1950. A more complete polycross comprising close to 500 resistant lines from all co-operating Stations and laboratories was established at Lethbridge and Saskatoon in 1952. The progeny of the polycross lines will be tested for agronomic superiority before the final selection is made. The selected lines will then be combined into a synthetic, wilt-resistant variety.

Irrigated Pastures

Irrigated pasture investigations had begun at Lethbridge by 1914. Kentucky blue grass was the main constituent of most pastures then, and the better mixtures had a carrying capacity of 1·7 animal units per acre. Some 1914 pastures still had good carrying capacity in 1943. Recently, however, the concept of irrigated pastures has changed, and highly productive mixtures that require intensive management, are proving to be more profitable.

During the four years 1948-1951, a test was conducted to determine the relative yielding ability and general suitability of 24 pasture mixtures under irrigation. The mixtures that proved to be superior are being tested further, using grazing animals.

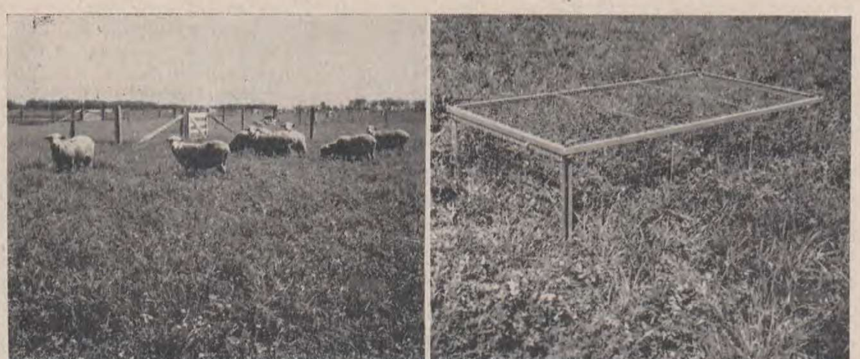


FIG. 8—*Left*: Irrigated pastures will carry up to 15 yearling ewes per acre during the grazing season. *Right*: Protective cages used to determine pasture yields by clipping.

The test helped to establish the value of many of the grasses and legumes. Orchard grass proved to be a promising grass and is included in most recommendations. It produced a good yield throughout the season, and recovered quickly from clippings. Smooth brome grass, reed canary grass, and creeping red fescue, also proved to be suitable pasture grasses, the latter providing excellent sod to withstand tramping. Kentucky blue grass, Canada blue grass, intermediate wheat grass, and timothy, produced relatively low yields, and are not recommended where high-yielding grasses are adapted. Crested wheat grass, Virginia wild rye, and big blue grass, yielded poorly, and will be eliminated from further trials. Mixtures containing white Dutch clover, and ladino clover, yielded at least as much as mixtures containing alfalfa.

As a result of the tests, a seed mixture of seven pounds of orchard grass, seven pounds of smooth brome grass, four pounds of creeping red fescue, and two pounds of white Dutch clover per acre has been recommended for permanent irrigated pasture on good land. Redtop and alsike clover, which grow well on wet land, produced a satisfactory yield, and a mixture of eight pounds of redtop and four pounds of alsike clover has been recommended for land subject to periodic flooding. A mixture of 12 pounds of smooth brome grass and two pounds of alfalfa yielded well for the first three years, and has been recommended for an economical short-term pasture. This recommendation is accompanied by a precautionary warning of the danger of bloat when a mixture is high in legumes, particularly alfalfa.

The period of high production of the recommended mixtures averaged 100 to 120 days. No mixtures produced at a uniform rate throughout the season, and most mixtures followed a similar pattern of production, which was a flush growth in spring and early summer, a decline in midsummer, a rise in late summer, and decline in early fall.

The period required for the recommended mixtures to recover from grazing is two to four weeks, depending on the time of season. This means that pastures being grazed in rotation should be allowed, on the average, three weeks to recover between grazings. Rapid recovery depends on the pasture being irrigated immediately following grazing during dry weather.

Rangeland Research

The Stavely Grassland Substation was established in 1948 following requests by interested organizations that range management problems in the foothills area of Alberta be investigated. After initial construction and fencing during the summer of 1948, actual grazing trials were started in 1949.

An initial survey using the point quadrat method, conducted in 1947, showed that the vegetation over the area was quite uniform in composition. A summary of this survey is shown in Table 12. Since that time point quadrat surveys have been conducted annually on each of the grazing fields.

TABLE 12.—VEGETATIONAL COVER OF THE FOUR QUARTER SECTIONS IN SECTION 21-14-29 W 4

Species	% Cover by quarters				Average for section
	N.W.	N.E.	S.W.	S.E.	
Parrys oat grass	5·70	5·70	6·40	4·60	5·92
Rough fescue	3·15	3·60	3·00	2·15	3·00
Idaho fescue	0·93	1·30	1·25	0·93	1·02
June grass	0·12	0·40	0·20	0·20	0·45
Western wheat grass	0·30	0·55	0·30	0·87	0·55
Other grasses	0·75	1·10	0·94	1·30	1·10
Sedges	0·50	0·62	0·93	0·93	0·69
Western snowberry	0·06	0·20	0·30	0·80	0·30
Silver lupine	0·12	0·35	0·25	0·12	0·20
Dandelion	0·70	0·75	0·40	1·50	0·80
Other forbs and shrubs	3·08	2·68	3·93	3·85	3·38

A consideration of Chart 2 reveals that several interesting trends are becoming evident. First, the cover of all grasses is showing a slight overall increase. This is to be expected under the conditions of the experiment for a few years at least. Later it is expected that the total cover of grass in the more heavily utilized fields will decrease while that in the lightly used areas will continue to increase, at least for a time.

Rough fescue. (*Festuca scabrella*) is obviously a grass that decreases in abundance with even relatively slight grazing use. This trend is quite marked in the most heavily utilized field.

Idaho fescue (*Festuca idahoensis*) shows an overall increase even in the most heavily utilized fields.

Parry's oat grass (*Danthonia parryi*) exhibits a general increase in most cases, a tendency that agrees with commonly held opinions regarding this grass. This species tends to increase in abundance at the expense of rough fescue where grazing is a factor. Parry's oat grass has contributed most to the increase noted in the figure labeled "Total Grass".

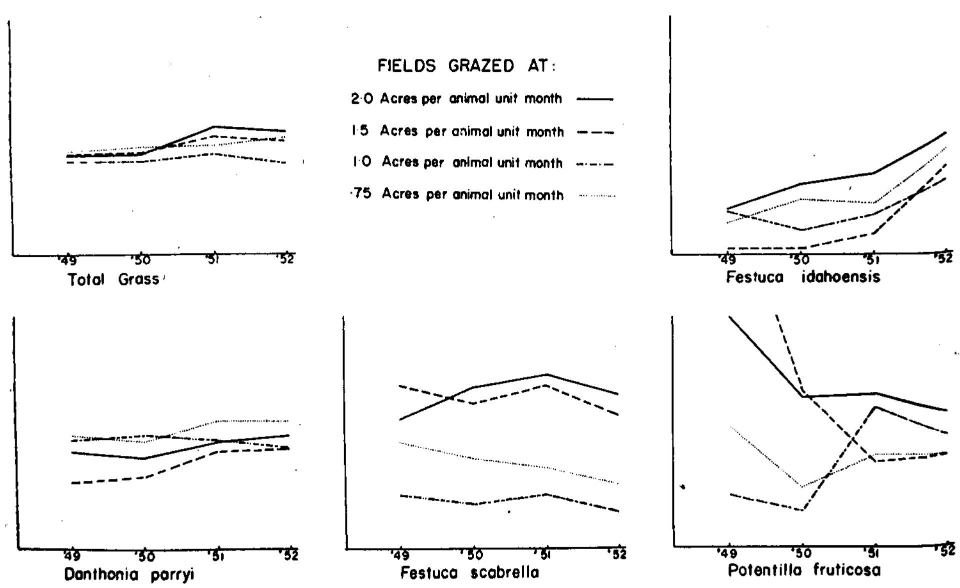
The cover of the forbs is somewhat erratic although there is a general increase in the more heavily utilized fields and a decrease in cover in those being utilized at a lighter rate of grazing. The same tendency is shown by the species shrubby cinquefoil (*Potentilla fruticosa*) a range weed of some consequence in heavily utilized areas of the foothills zone.

The status of certain other range plants is not clear at present and it will require a period of several years for the trends to become apparent. However, three-flowered avens (*Geum triflora*), northern bedstraw (*Galium boreale*), and crocus (*Pulsatilla ludoviciana*) all increase markedly with continued heavy use and their abundance is indicative of an overgrazed condition.

TRENDS IN VEGETATIVE COVER

STAVELY GRASSLAND SUBSTATION.

1949 - 1952



Cattle weights obtained on the experimental fields show a marked decrease in gain with heavier rates of grazing.

TABLE 13.—AVERAGE SEASONAL GAINS OF COWS, 1949–1952

No. Head	Grazing rate	2-years — 1949	3-years — 1950	4-years — 1951	5-years — 1952
		lb.	lb.	lb.	lb.
13	2·0 acres per animal unit month	251	327	190	186
13	1·5 acres per animal unit month	273	307	168	151
13	1·0 acres per animal unit month	214	285	155	168
13	0·75 acres per animal unit month	203	283	44	100

ANIMAL HUSBANDRY

Animal nutrition and wool research along with livestock breeding and management are the main divisions of Animal Husbandry investigations. Recent expansion of facilities and equipment at this Station are enabling trained personnel to accurately study a wide range of problems pertinent to the livestock industry of Western Canada.

Animal Nutrition Research

Lambs from Ewes Fed Peavine Silage Develop a Paralysis.—It was observed for a number of years that when pregnant ewes were fed peavine silage many of the lambs showed symptoms of paralysis and inco-ordination. Experiments were initiated in 1948 to determine the cause of this condition. It has been shown that when the same ewes were fed alfalfa hay and oat hay instead of peavine silage, cases of paralysis did not occur; also that the condition could not be prevented by supplementing the peavine silage with cobalt, copper, vitamin A, or vitamin E. This study is being continued.

Protein Content of the Ration for Pregnant and Lactating Ewes Affects Lamb Production.—Three groups of range ewes were individually fed rations containing 7, 10, and 13 per cent total protein from June, 1949, to June, 1950. The rations contained 70 per cent grass hay and 30 per cent concentrates (oats, starch, linseed oilmeal, and minerals).

From the results obtained it was evident that increasing the protein content of the ration from 7 to 10 per cent increased the birth weights, the weights at 6 weeks of age, and the weaning weights of the lambs as well as the number of lambs raised. Increasing the protein from 10 to 13 per cent did not significantly increase the weights or number of lambs raised.

Three groups of range ewes were individually fed rations containing 7·7 per cent, 7·7 per cent raised to 10·5 per cent six weeks before lambing, and 10·5 per cent protein from June, 1950, until September, 1951. The rations were similar in composition to those used in the previous year.

Results provided no justification for supplementing the ration of pregnant ewes with high-protein feeds until approximately 6 weeks before lambing is to begin, nor is there a need to feed high-protein rations (above 11 per cent) during the latter part of pregnancy and during lactation provided the ewes are receiving sufficient quantities of good quality feed.

Milk production studies conducted on the ewes used in these experiments showed that ewes on the 7 per cent protein rations did not produce so much milk as those fed the 10 per cent protein ration.

Supplementing Range Ewes Before Lambing.—A supplement of one pound of grain per head daily fed to a group of Rambouillet ewes (102 head) during the last six weeks before lambing did not result in any significant increase in birth weight of lambs or the weight of the lambs at weaning when compared with a similar group that received no supplement. The ewes in this experiment, which was carried out for only one year, had good winter range. Green grass was available during lambing. The results might have been different had there not been good winter range available, or had green grass not been available during lambing.

Cull Potatoes for Feeder Lambs and Dairy Cows.—When cull potatoes (small and off-grade) were fed to feeder lambs at the rate of two pounds per head daily along with alfalfa hay and grain in comparison with lambs fed a similar ration but which did not contain potatoes, it was found that one ton of potatoes was worth approximately 15 per cent of the value of a ton of grain.

When fed to milking dairy cows at the rate of 30 pounds per day along with alfalfa hay and grain one ton of potatoes was worth approximately 20 per cent of the value of a ton of grain. Quite noticeable off-flavors were detected in the milk from the potato-fed group during one year of the experiment but no off-flavors were detected in the second year. It is thought that the off-flavors were due to the feeding of slightly spoiled potatoes. The potatoes were sliced before feeding and proved to be a very palatable feed.

Legume Seed Screenings as a Protein Supplement for Lambs.—Legume seed screenings (broken and shrunken alfalfa and clover seeds and weed seeds) from seed cleaning plants contain approximately 32 per cent protein. These screenings were fed to ram lambs at the rate of 0·2 pound per head daily during 1949-50 and 0·3 pound per head daily during 1950-51 along with grass hay and grain. The lambs gained at the same rate as similar lambs fed equal amounts of linseed oilcake. The screenings were fed in the unground state and proved to be palatable. In these tests legume seed screenings were a suitable high-protein supplement for sheep. Precaution should be taken against the spread of weed seeds when this feed is fed.

Sugar Beet Top Silage for Fattening Lambs and Cattle.—From the results of three experiments with fattening yearling steers to compare the value of sugar beet tops preserved as silage with alfalfa hay, each ton of silage (34 per cent dry matter) had a value equivalent to 575 pounds of alfalfa hay and 30 pounds of grain. When the same silage was fed to feeder lambs during two experiments each ton of silage was worth approximately 500 pounds of alfalfa hay. If hay is valued at $20 per ton and it is assumed that the yield of silage is 800 pounds per ton of harvested beets the value of the tops from an acre of beets (12 tons of beets per acre) as a feed for fattening stock would be approximately $25.

Because of the laxative nature of beet tops, they should not make up over one-half of the roughage allowance for fattening animals. Beet tops are a good source of protein (about the same as alfalfa hay), are low in fiber but have a high content of mineral matter.

Peavine Silage or Hay for Fattening Lambs and Cattle.—Experiments were conducted with steers and lambs to compare peavine silage and hay with alfalfa hay as the sole roughage for fattening. The results showed that peavine silage (25 per cent dry matter) and peavine hay were equal to alfalfa hay (on an equivalent moisture basis) as a fattening feed. In chemical composition the peavines were similar to medium-good-quality first-cutting alfalfa hay.

Vitamin A Reserves of Feeder Lambs.—There is some evidence that, especially after a year of drought, range livestock suffer from a vitamin A deficiency. Since the liver is the chief storage site for vitamin A within the body, the liver reserves of feeder lambs coming off the range in the fall of the year were determined. The average reserves of five to eight lambs each year varied from 175 International Units in 1948 to 1,180 International Units in 1951.

The amount of vitamin A in the livers was very closely related to the amount of green forage available during the previous grazing season. Vitamin A reserves were determined in similar lambs after being on feed for a period of 100 days and receiving various roughages, ranging from wheat straw to alfalfa hay. Only in the spring of 1949 were the reserves low. These results indicate that vitamin A deficiency is not a serious problem among range sheep in southern Alberta except after years of prolonged drought.

Cobalt Supplements for Feeder Lambs Fed Non-Leguminous Hays.—There is evidence that feeds grown in certain areas of Alberta do not contain sufficient cobalt to supply the needs of cattle and sheep. To determine whether sheep when fed grass hay along with a grain mixture would benefit from a cobalt supplement, experiments were carried out over a four-year period. During the first winter the cobalt-supplemented group made approximately 19 per cent greater average daily gains than a comparable non-supplemented group and required 15 per cent less feed to make 100 pounds of gain. However, during the other three winters there were no differences in gain or efficiency of feed utilization between supplemented and non-supplemented groups. The cobalt analyses of the feeds showed that during the first year the cobalt content was considerably less than that during the other three years. Experiments at other Stations in Western Canada have shown similar results. Due to the very small amount of cobalt required by cattle and sheep it is suggested the cobaltized salt be fed, especially if non-legume hays are fed.

Wool Research

Wool Survey Shows Value of Selection for Fleece Weight.—A high degree of variability has been found by the Wool Research Laboratory in fleece weights obtained from 15 different flocks in southern Alberta. Individual grease weights ranged from 5·9 to 15 pounds with an average difference of 5 pounds between the highest and lowest producers in each flock. When valued at 45 cents per pound this meant that in the same flock some ewes were returning $2.25 per head more than others for approximately the same investment. The average fleece weights per flock ranged from 8·2 to 10·0 pounds. This represents an increased return of 90 cents per head in favor of the high producer and serves to emphasize the possibility of increased income through greater care in the selection of breeding stock.

It was found that the grade had a marked effect on wool production and fleece value. As the wool became coarser the average raw and clean fleece weights increased whereas the percentage of shrinkage decreased. However, it was noted that the fleece values by grades did not follow this general trend. Fine-medium was the most valuable grade of wool during the period studied. This grade returned 20 cents more per fleece to the grower than the fine or medium wools and 44 cents more than low-medium.

Protein Level in Feed for Ewes Affects Wool Production.—The importance of adequate amounts of protein has been shown by the results from an experiment conducted at this Station. Three lots of mature ewes were fed pelleted rations containing 7, 10, and 13 per cent protein respectively to determine its effect on wool production. Table 14 summarizes the results of this experiment.

TABLE 14.—WOOL PRODUCTION AS AFFECTED BY LEVEL OF PROTEIN IN THE EWE'S RATION

Level of protein fed	Average grease fleece weight	Average clean fleece weight	Average fiber length	Average fiber thickness
	lb.	lb.	mm.	microns
7 per cent	9·4	4·8	83·5	25·4
10 per cent	11·3	5·6	89·9	25·8
13 per cent	12·1	5·7	93·9	26·1

Raw fleece weights were increased considerably by each addition of 3 per cent protein to the basal ration, amounting to approximately 16 and 25 per cent respectively. Clean fleece weights, fiber thicknesses, and staple lengths responded markedly to the first increase in level of protein but the response to the second increase was negligible. It was noted during the course of this experiment that additional stresses on the body, such as advanced pregnancy and lactation, materially reduced wool growth. During such periods higher protein feeding is needed to meet all the body requirements for this essential nutrient.

Wool Production of Range Breeds Compared.—The Canadian Corriedale and the Romnelet have been maintained under similar conditions at Lethbridge and at Manyberries to test their relative productive capacities. (The Lethbridge range was located at the Sheep Substation, Scandia, Alta.). The Rambouillet also was included in the study at Lethbridge. Table 15 shows the wool production of these sheep under different environmental conditions at the two stations.

TABLE 15.—AVERAGE WOOL PRODUCTION OF THREE BREEDS AT TWO STATIONS, 1948–51

—	Raw fleece weight	Clean fleece weight	Staple length	Fiber thickness
	lb.	lb.	mm.	microns
Lethbridge				
Canadian Corriedale	9·9	4·6	95·0	25·7
Romnelet	9·5	4·7	92·6	28·1
Rambouillet	11·5	4·9	77·4	21·6
Manyberries				
Canadian Corriedale	11·3	5·3	106·5	26·4
Romnelet	10·6	5·3	98·1	29·1
Stations Combined				
Canadian Corriedale	10·5	4·9	100·7	26·0
Romnelet	10·1	5·0	95·4	28·7

No differences in wool production were found between the Canadian Corriedale or the Romnelet at either Lethbridge or Manyberries. However, the Rambouillet was superior to both the other breeds at Lethbridge. The most striking feature of this study was the difference in production between the two Stations. The sheep at Manyberries produced over one-half pound more clean wool than those at Lethbridge. This increased production was reflected in greater staple length and fiber thickness.

Heavier Ewes Produce More Wool.—Recent studies have shown that the raw-fleece weights of mature ewes are closely related to their body weights. It was found that Rambouillet ewes weighing 105 pounds produced 10·6 pounds of raw wool while those weighing 150 pounds and over sheared 12·8 pounds. This increase of 2·2 pounds, when valued at 45 cents per pound, represented an increased return of 99 cents per head in favor of the heavier ewes. Similar results also were obtained from Canadian Corriedale ewes. Since it cost approximately the same to maintain a small ewe as a large one under range conditions this increase is profit. This fact should assist in focusing the wool growers' attention on the need for careful selection and culling of breeding stock if they are to increase the average wool production of their flocks.

Yearling Clean-Fleece Weight Closely Related to Mature Wool Production.—Early selection for maximum annual wool production is important if progress is to be made through breeding. To determine the relative efficiency of yearling clean-fleece weight as an index of maximum mature wool production, data on successive clean-fleece weights were obtained from ewes of several different breeds throughout their productive period.

It was found that 70 per cent of the maximum annual weight of clean wool grown by Canadian Corriedales, Romnelets, and Rambouillets was produced as yearlings. There is a high correlation between first year and maximum production for all breeds. It is interesting to note that Romnelets reached their maximum wool production at two years of age while the Corriedales and the Rambouillets reached maturity in their third year. It is evident that selection of future breeding stock on the basis of yearling clean-fleece weight would be a useful aid in increasing wool production.

Soluble Fluids for Branding Sheep.—Much interest has developed in the production of a sheep branding fluid that is not only durable for periods of at least 12 months but that will scour out completely during processing. This has proved to be a difficult task as it has been found that those branding fluids that were both durable and legible did not scour out readily whereas those that scoured out of the wool remained legible for only short periods of time.

It has been a common practice on many ranches and farms to mark the sheep with such materials as tar, lead paint, transmission oils, and other non-scouring substances. This always has created a serious problem in the manufacture of woolen and worsted fabrics because the operations involved in removing the impurities from the wool are costly.

Trials have been under way at this Station to test a number of these new "scourable" fluids under range conditions. Branding fluids of four different colors from three commercial companies were tested and it was found that the branding fluid scoured out of the wool satisfactory, but the brands were barely legible at the end of 12 months. Red and blue colors remained legible longer than green or black. It was noted also that to extend the period of legibility brands should be placed on the back of the sheep so that they would not be worn off by rubbing.

Livestock Breeding and Management

Dairy Cattle Breeding.—A herd of purebred Holstein-Friesian cattle is maintained on the Station for breeding, nutritional, housing, and management studies. The average size of the herd, including young stock, was 42 head during the period 1946 to 1951. During 1951 the herd was increased to approximately 100 head. The breeding and selection program has aimed at producing a herd of good dairy-type cows with high butterfat and milk production. A large number of young bulls have been sold to dairymen in the area. The herd is accredited for Bang's disease and tuberculosis and all heifers have been vaccinated against Bang's disease since 1951.

Record of Performance.—All cows freshening in the herd have been entered on R.O.P. During the years 1947 to 1952, 97 cows completed lactations, twelve of them having records too low for R.O.P. qualifications. The average milk production for the period was 12,453 pounds and fat production was 461 pounds. The milk and fat indexes were 1·24 and 1·36 respectively. The average fat test for the period was 3·70 per cent.

Feed Costs of Milk Production.—The cost of feed for milk production is an important factor in determining the margin of profit from a dairy herd. Feed costs for six years, 1947 to 1952, inclusive, are presented in Table 16.

TABLE 16.—AVERAGE MONTHLY PRODUCTION, QUANTITIES OF FEED AND COST OF FEED FOR PRODUCING MILK AND BUTTERFAT

Year	Average production		Feed cost $		Feed consumed per 100 lb. milk			
	Milk	Fat	Per 100 lb. milk	Per 1 lb. fat	Meal lb.	Ensilage lb.	Hay lb.	Pasture Days
	lb.	lb.						
1947	990·4	37·2	1·14	0·30	34·5	—	74·7	1·1
1948	918·6	34·6	1·29	0·34	29·2	8·6	72·7	1·4
1949	932·4	34·9	1·37	0·36	28·6	8·2	89·7	0·8
1950	922·1	34·6	1·23	0·33	27·3	30·3	66·7	0·9
1951	734·4	27·5	1·31	0·35	22·4	20·0	89·9	1·4
1952	828·4	28·7	2·13	0·61	38·4	4·8	62·8	1·7

The season of the year makes considerable difference in feed costs. Table 17 summarizes feed costs for milk production for summer (May to October) and winter (November to April).

TABLE 17.—AVERAGE WINTER AND SUMMER FEED COSTS FOR MILK PRODUCTION

Time	Average production		Feed cost $		Feed consumed per 100 lb. of milk			
	Milk	Fat	Per 100 lb. milk	Per 1 lb. Fat	Meal lb.	Ensilage lb.	Hay lb.	Pasture Days
	lb.	lb.						
Summer	1,024·6	38·7	0·94	0·25	26·3	6·5	37·6	1·9
Winter	773·4	28·8	1·71	0·46	31·5	23·4	132·0	0·08

Summer production when cows are on grass is slightly more than half as expensive as winter production. Data obtained in 1952 provide some interesting information concerning the value of good irrigated pastures for milk production. After deducting the cost of all barn-fed concentrates and hay, one 10-acre pasture produced $270 worth of milk per acre during the 1952 grazing season. Another 12-acre pasture seeded in the spring of 1952 produced $124 worth of milk per acre when grazed by 48 cows for a period of 26 days in late September and early October, 1952. Table 18 shows the average milk production and feed costs of cows freshening during various periods of the year.

TABLE 18.—AVERAGE MILK PRODUCTION AND FEED COSTS OF COWS FRESHENING DURING VARIOUS PERIODS OF THE YEAR, 1936–1950

—	Average milk production	Average fat production	Feed costs	
			Per 100 lb. milk	Per lb. fat
	lb.	lb.	$	$
Nov.—March	12,741·6	466·1	0·81	0·22
Apr.—July	12,509·7	457·8	01·1	0·28
Aug.—Oct.	12,813·1	457·8	0·68	0·19

These data indicate that the cows freshening during the period of August to October, inclusive, produced milk at a lower feed cost than those freshening during April to July, while November to March was intermediate.

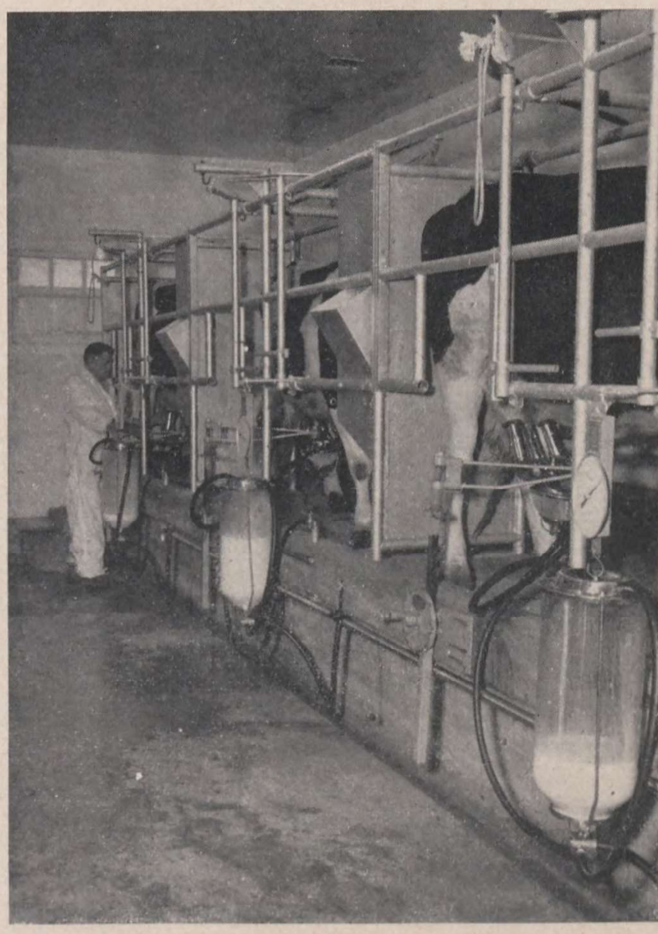


FIG. 9—Cows being milked in the elevated milking stalls in the milking parlor of the loose housing barn. A pipe line milker is used.

Loose Housing versus Conventional Barn.—An experiment was started in 1951 to compare loose housing and conventional barns for dairy cattle. During the winter of 1951-52 cows in the loose housing barn produced 33·8 pounds of milk per day and cows in the main barn produced 33·2 pounds of milk per day. Bedding requirement per cow was significantly greater in loose housing. The cows were easily acclimatized to new surroundings and to the change of milking systems when they were moved from one barn to another.

Comparable herds of 24 cows are being maintained under each system of housing and calves are being raised in both barns. There is a substantial saving in investment per cow under the loose housing system and labor costs are considerably less than in the stanchion-type barn. Milk quality in both barns has been satisfactory from the standpoint of low bacteria count. Accurate information on feed consumption, labor requirements, animal health, and milk production will be available for both systems of housing and management by 1955.

Sheep Breeding.—The sheep breeding program for the Lethbridge Station was carried on at the Sheep Station at Scandia, Alta., until 1952 when the flock at Scandia was moved to the Manyberries Range Station where the sheep breeding work will be continued.

Rambouillet Sheep.—The Rambouillet breed is still the basic range sheep for the range areas. The Rambouillet breeding program has aimed at improving body conformation, wool production, face cover, and wrinkling. The reduction of the face cover has been the most difficult problem. A polled strain of Rambouillet sheep is being developed. Approximately 40 rams of this breed have been sold each year to sheepmen in southern Alberta.

New Zealand Corriedale.—A small flock of purebred New Zealand Corriedale sheep has been maintained to provide rams for breeding experiments. The ewes of this breed are rather small and are low in prolificacy. Rams of this breed are popular with some ranchers and small-flock owners. The offspring from these rams mated with white faced ewes of Rambouillet breeding have good body conformation. The New Zealand Corriedale seemed to be the least suitable range breed for this area and the small flock was disposed of in 1952.

Canadian Corriedale Sheep.—The improvement of the Canadian Corriedale breed is an important part of the sheep breeding program at Lethbridge. The Canadian Corriedale has been criticized for lacking size and vigor and a breeding program is being carried on to infuse these characteristics into the present Canadian Corriedale flock by a crossbreeding program. Some production characteristics of different breeds in the Lethbridge flock are shown in Table 19.

TABLE 19.—SUMMARY OF PRODUCTION OF DIFFERENT BREEDS OF SHEEP, 1947–1952

Breed of ewes	Breeds of rams	Bred ewes that lambed	Lambing percentage based on ewes that lambed	Birth weights	
				Males	Females
		%		lb.	lb.
N.Z. Corriedale	N.Z. Corriedale	92·9	111·0	9·4	9·0
Canadian Corriedale	Canadian Corriedale	93·2	135·7	9·2	8·6
C2	Canadian Corriedale	84·7	137·1	9·8	8·9
Romnelet[1]	Romnelet	93·5	137·8	9·2	8·6
Rambouillet	Rambouillet	94·0	134·5	9·8	9·2
Rambouillet[2]	N.Z. Corriedale	92·8	137·5	10·2	9·3

[1] 1949–1952.
[2] 1950–1952.

A Comparison of Three Breeds of Range Sheep.—A co-operative project with the Manyberries Range Station was carried out to compare the relative productivity of the Rambouillet, Canadian Corriedale, and Romnelet breeds of sheep at Lethbridge and the Canadian Corriedale and Romnelet breeds at Manyberries. Fifty ewes of each breed were selected for the comparison.

From a summary of three years data the birth weights of the lambs were: Rambouillet, 9·6 pounds; Canadian Corriedale, 9·4 pounds; and Romnelet, 8·8 pounds. The Romnelet lambs were significantly lighter than the other two breeds.

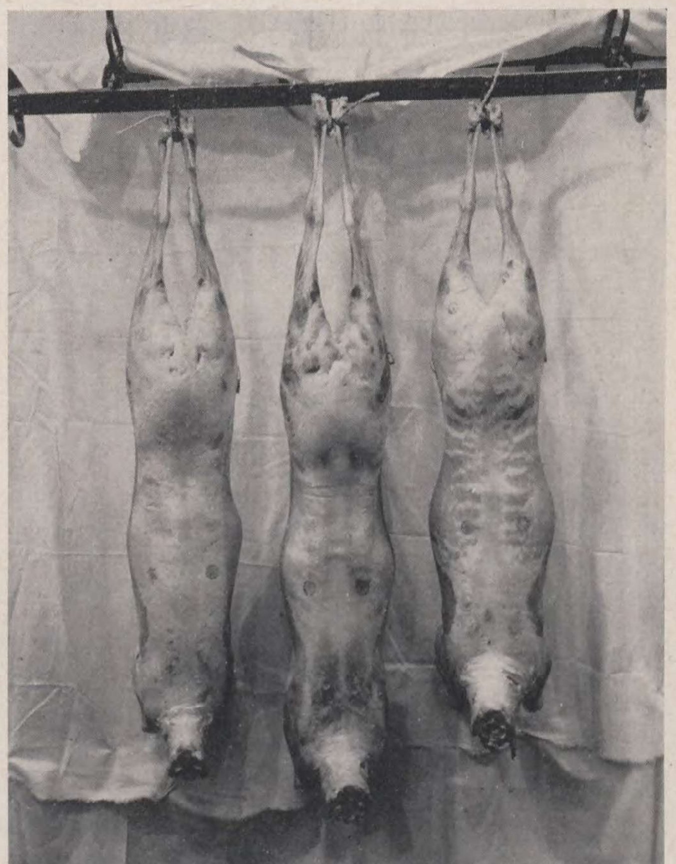


FIG. 10—Typical lamb carcasses. *Left to right*: Canadian Corriedale, Rambouillet, and Romnelet.

The Rambouillet ewes weaned significantly heavier single lambs than the other two breeds. There was little difference in the weaning weights of the Romnelet and Canadian Corriedale lambs.

There were no significant differences between breeds in average daily gains, efficiency of feed utilization, or dressing percentage when the lambs were fed in the feedlot. The Rambouillet had a significantly lower carcass score than the other two breeds.

The Rambouillet ewes were the heaviest breed at the Scandia Station. The Rambouillet ewes weighed 134·6 pounds at breeding time, the Canadian Corriedale 123·0 pounds, and the Romnelet 120·8 pounds. (Note: Wool production data is presented in the Wool Section of this report.)

The "Elastrator" for Castrating and Docking Lambs.—The "Elastrator" and "Knife" for castrating and docking lambs have been compared at this Station. There have been no differences in the results from the two methods with respect to rate of gain, weaning weight, mortality from birth to weaning, and feedlot performance.

Spraying for Ked (Tick) Control.—Spraying, using recommended chemicals, has proved to be an effective and satisfactory method for controlling keds in range sheep. The Scandia flock has been sprayed about three weeks after shearing for a number of years. Spraying is quicker and is easier on the flock and operators than the old dipping method.

POULTRY HUSBANDRY

Prior to 1950 a Barred Plymouth Rock flock was maintained at the Station in connection with poultry research. In 1950 a major reorganization of the poultry investigations was made and the above flock was disposed of.

Selective breeding combined with sound management in the Barred Rock flock increased egg production to an average of 207 eggs for pullets in their first year of production for the period 1948 to 1950, inclusive. This compares favorably with an average of 195 eggs per bird in the years immediately after this flock was established at this Station. Egg size was increased from 22·4 ounces per dozen to 26·3 ounces per dozen in a 10-year period.

Fig. 11—Twelve-weeks-old broilers raised in 1952. *Left*, Broad Breasted White and *right*, New Hampshires, with crossed progeny in the centre.

In 1950 a new 1,000-bird laying house was completed and filled with birds of White Leghorn, Broad Breasted White, and Hybrid breeding. The above birds were hatched at the Central Experimental Farm, Ottawa, and shipped by air express to Lethbridge as day-old chicks for the following co-operative projects.

The White Leghorns are the basic breed in a project to determine the feasibility of selection based on the progeny test as a method for increasing the egg producing ability of fowl. The Broad Breasted White birds, a meat breed developed by the Central Experimental Farm at Ottawa, are being used in connection with an environmental test for the improvement of these meat birds. The performance of this new breed has been encouraging as the birds exhibit exceptional qualities for the broiler trade and produce a creditable number of eggs. Hybrid birds have given an excellent account of themselves from the standpoint of egg production.

Early in 1952 a project was commenced to test the possible toxicity of coal cinders used in poultry runs with negative evidence of toxicity indicated at the end of the first year.

Well equipped poultry killing facilities as well as brooding quarters have been installed in connection with the above poultry projects. Many recent developments in up-to-date poultry equipment and management are being tested in the current poultry research program. Fan ventilation, thermostatic controls, automatic waterers, trap-nests, self-feeders, dropping-boards made of various materials, mechanical conveyors for litter and feed, the use of deep litter, modern trap-nests, and poultry ranges are among the major items that are receiving close study.

DISTRICT EXPERIMENT SUBSTATIONS

District Experiment Substations are privately-owned farms where problems are studied in their local environment. These investigations constitute an important extension of the comprehensive work conducted on the Experimental Farms and Stations. There are ten District Experiment Substations, and two special-project Stations, which serve the outlying areas surrounding the Dominion Experimental Station at Lethbridge. The locations of these Substations and the names of the owners are: Acadia Valley, W. A. Heiden; Bindloss, J. Barnes; Claresholm, D. L. Reynolds; Craigmyle, J. L. Branum; Drumheller, Andrew Bros.; Foremost, C. G. Wolfe; Lomond, E. M. Benson; Nobleford, G. J. Withage; Pincher Creek, E. P. Cyr; Whitla, W. Babe. The special-project Stations are located at Taber and Dalroy. The great variety of soil textures from fine sandy loam at Claresholm to clay at Pincher Creek, and climate peculiar to the individual Substations, permit investigations of agricultural practices under a wide range of conditions.

Erosion Control

The control of both wind and water erosion is one of the important functions on the Substations. Strip farming in conjunction with trash cover summerfallowing has controlled wind erosion effectively on the Substations. The width of strips varies from 13⅓ rods to 40 rods. On the fine sandy loam and clay soils, the narrow strips are recommended, while wider strips can be used on the soils of medium texture if an adequate trash cover can be maintained on the soil surface during the summerfallow period. The blade-type cultivator has been the most effective implement for maintaining the most trash on the surface during summerfallow operations. Seeding one bushel of oats on summerfallow about the middle of July at the Pincher Creek and Claresholm Substations has served a very useful purpose most years for control of soil drifting and provision of fall pasture.

Water erosion in waterways has been stopped by establishing a good grass cover after the waterways have been widened and levelled.

Wherever the topography and precipitation warrant it, contour strip cropping has been established on the Substations. At the Pincher Creek Substation, a modified system of contour strip cropping was established, alternating grass land and cultivated strips. A large part of the Nobleford Substation is strip cropped on the contour, alternating fallow and cereal crops. The strips are alternately regular and irregular in width. Contour strip cropping is in operation at the Drumheller Substation. A combination of grassed waterways, trash cover, and contour strip cropping has prevented serious water erosion, increased crop production, and eased field operation.

Cereal Variety Studies

Cereals, especially wheat, are the major source of revenue for the farms in southern Alberta. Therefore, extensive rod-row cereal variety tests are conducted each year on the Substations. The primary purpose is to determine, in each locality, the suitability of some of the new varieties and strains in comparison with those already in use.

Thatcher wheat is recommended for all of the soil climatic zones of southern Alberta. Chinook and Rescue spring wheats are recommended for use in the brown soil zones wherever the sawfly is a problem. Saunders is recommended for the areas where there is a frost hazard and earlier maturity is important. Compana and Vantage barley are recommended for the areas served by the southern Alberta Substations, except along the eastern edge of the foothills where moisture is more abundant. Compana is not recommended here because of its susceptibility to lodging. Ajax and Victory oats and Royal flax are the varieties recommended for zone 1. Eagle oats and Dakota flax are the varieties for the other areas, except where the growing season is shorter, where Redwing is the best flax variety.

The District Experiment Substations are a source of supply for the recommended cereal varieties and act as points for multiplication and distribution of seed of superior varieties. During the past six years, 60,734 bushels of seed grain have been distributed from the Substations.

Chemical Fertilizers for Wheat

Chemical fertilizers have been tested in rod-row and field-scale tests for twelve years on the Substations. To date, chemical fertilizers tested have not given consistent yield increases at the Substations in soil zone 1, except at Acadia Valley where the soil is a clay. There, ammonium phosphate 11-48-0, applied at the rate of 50 pounds per acre, has given an average increase of 3·9 bushels of wheat per acre. In soil zones 2 and 3, where moisture is more abundant, chemical fertilizer response is more pronounced. In these zones, 11-48-0 applied at the rate of 50 pounds per acre, gave average increased wheat yields ranging from 2·2 to 9·8 bushels per acre, the greater increases occurring in the higher-rainfall areas.

The Farm Business

A study of the farm business conducted on the Substation reveals some interesting information. At the end of each year an inventory is taken. This shows the utilization of land, capital investment in land, buildings, livestock and equipment, supplies on hand, and farm indebtedness. Farm revenue and expenditure are reported each week and this is the basis for determining cash revenue for the year from various enterprises.

Operators received 69·4 per cent of their total revenue from field crops during the six-year period 1947-52. Livestock, almost wholly beef cattle, contributed 18·6 per cent. During this six-year period, hogs accounted for only 2·4 per cent of the total, and machinery and buildings amounted to 7·5 per cent. Poultry, custom work, and farm produce to the household made up 2·1 per cent of the total.

Yields and Cost of Producing Wheat

This investigation into the cost of growing wheat on the Substations is conducted with the general object of discovering ways and means of securing greater economy in production. The objective is not that of determining what constitutes a fair price. It will be thought that the cost data in Table 20 are too low. Considering the district as a whole, which surrounds each Substation, this is true. Relatively higher yields and a consequent lessening in the cost of producing wheat on Substation farms has resulted from the institution of a program of erosion control, moisture conservation, and the use of improved varieties. In most cases the cultivated acreage on Substation farms is greater than the average and this is important in reducing costs of production.

TABLE 20.—SUMMARY OF YIELDS AND COST OF PRODUCTION OF WHEAT AFTER FALLOW. SOUTHERN ALBERTA SUBSTATIONS

Station	No. years grown	Yield per acre average	Cost per acre average	Cost per bushel average
Acadia Valley	14	21·8	9·90	0·57
Bindloss	18	14·9	8·77	0·63
Foremost	16	16·6	8·93	0·55
Lomond	18	16·4	9·13	0·59
Whitla	18	10·6	7·03	0·73
Claresholm	16	22·0	11·70	0·52
Craigmyle	14	22·2	13·75	0·61
Drumheller	16	21·4	11·56	0·55
Nobleford	14	33·5	19·09	0·55
Pincher Creek	18	31·8	16·38	0·48

Field Days

Field days have been held annually at all Substations to acquaint farmers with the work being conducted on the Substations and on the Experimental Farms. Officials of the Canada and Alberta Departments of Agriculture have co-operated in presenting interesting and instructive programs which over the years have covered practically every phase of agriculture. A total of 6,005 farmers attended these field days during the six years 1947 to 1952.

LIST OF ACTIVE PROJECTS

Field Husbandry

Cultural studies with dry land cereal crops, fertilizer studies, sugar beet investigations, weed control projects, dry land and irrigated crop rotations, and machinery and equipment investigations.

Irrigation

Consumptive use of water for irrigated crops, effect of irrigation on quality, amount required for maximum yields, value of sprinkler irrigation, farm use of water, and climatic factors affecting water requirement.

Cereals

Testing varieties and strains of hard red spring wheat, soft white spring wheat, hard red winter wheat, winter rye, barley, oats, flax, field beans, field peas, and safflower, breeding superior varieties of cereal crops for both dry and irrigated areas, breeding new combinations of germ plasm for parent material, production and maintenance of Foundation, Elite, and other seed stocks.

Horticulture

Cultural and variety studies on vegetables, fruits and ornamentals, breeding improved vegetables, tree fruits, and small fruits, and canning, freezing, and nutrient studies of vegetables and fruits.

Forage Crops

Comparative testing, plant breeding, and evaluation of forage crops for hay, pasture and seed production, irrigated pasture studies, research on rates of grazing and management of native range vegetation.

Animal Husbandry and Poultry

Nutritional experiments with beef cattle, dairy cattle, sheep, swine, and small animals, housing and management studies with diary cattle, metabolism studies with sheep and swine, irrigated pasture investigations, wool investigations, breeding and nutritional research with egg- and meat-producing fowl.

District Experiment Substations

Meteorological studies, controlling wind and water erosion, rotation studies, soil fertility, cultural methods, testing cereal varieties, testing forage crops, and farm management studies.

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