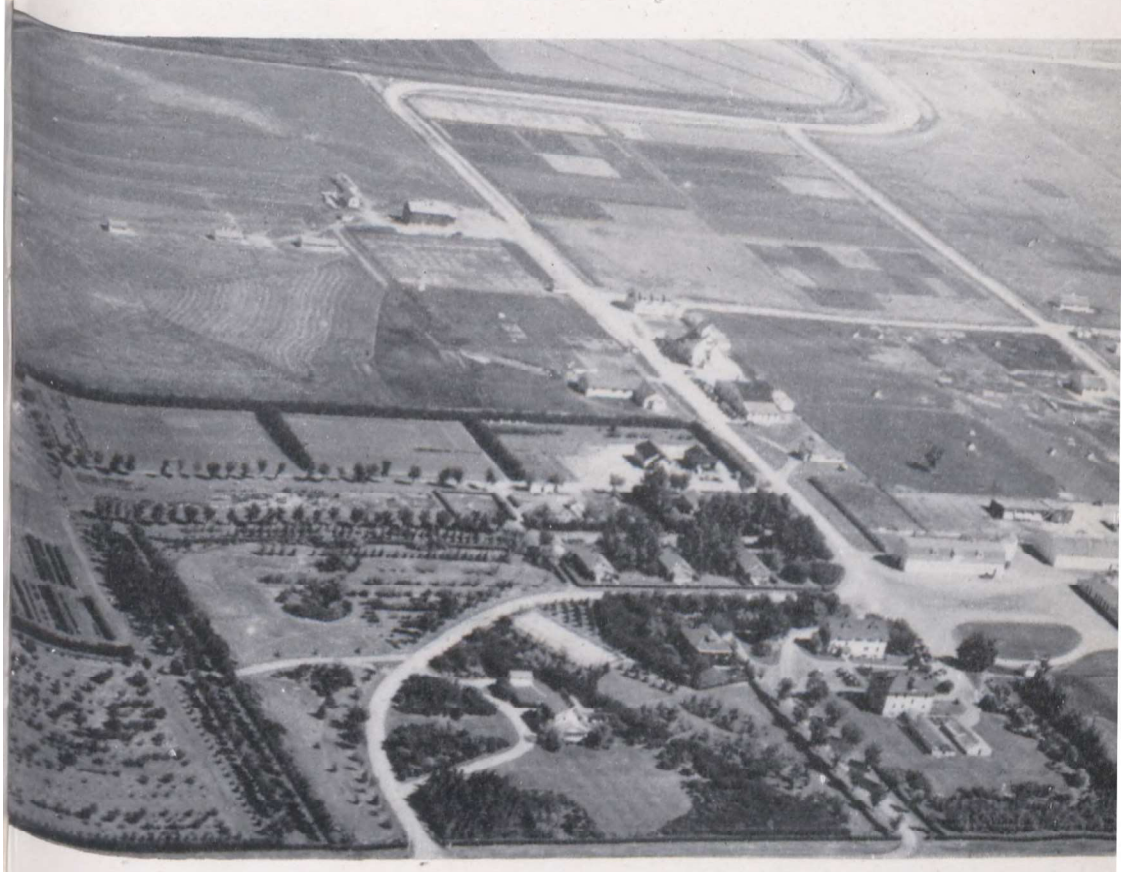
CANADA
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS SERVICE

DOMINION EXPERIMENTAL STATION
SWIFT CURRENT
SASK.

L. B. THOMSON, B. Sc., SUPERINTENDENT

PROGRESS REPORT
1937-1947



AERIAL PHOTOGRAPH OF
SWIFT CURRENT
EXPERIMENTAL STATION, 1947

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

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DOMINION EXPERIMENTAL STATION
SWIFT CURRENT, SASK.

Results of Experiments, 1937-1947

INTRODUCTION

The Dominion Experimental Station at Swift Current, Saskatchewan, established in 1921, has conducted a comprehensive program of research and experimental work designed to learn the best agricultural methods applicable, primarily, for southwestern Saskatchewan. The "Royal Commission of Enquiry into Farming Conditions" which was appointed in 1920 listed a large number of problems that were facing farmers at that time, following a series of dry years and crop failures. From 1929 to 1938 another even more severe period of drought and soil drifting occurred, to be again succeeded by more favourable years. Experiments have been conducted at the Experimental Station not only in relation to drought and its closely associated problems of soil erosion, reclamation of lands and conservation of moisture, but also in all those phases of agricultural production involving the better use of land and the improvement of the farm income.

At the Swift Current Experimental Station the main divisions of work are Agricultural Engineering, Field Husbandry, District Experiment Substations, Forage Plants, Pasture Studies, Plant Breeding of Cereals, Animal Husbandry and Turkey Production. The establishment of several District Experiment Substations in 1935 permitted a much wider scope in the operations of the Swift Current Experimental Station in the study of methods of soil drifting control under different soil and climatic conditions.

A staff of agricultural engineers conducts studies designed to serve farmers through the application of engineering principles to agriculture. Forage plant specialists undertake special studies and surveys, in co-operation with scientists from other Dominion Experimental Stations, to learn the best methods of improving the livestock returns from the grazing and pasture lands of Saskatchewan, Manitoba, Alberta and British Columbia.

Annual reports from the Swift Current Experimental Station were published each year, for the years 1922 to 1930, inclusive. A progress report, giving the results of experimental work at the Station, was published in 1937, covering the period 1931 to 1936, inclusive. From time to time special bulletins have been published and are available, upon application, for distribution to anyone interested. This progress report gives the results of experiments for the years 1937-1947, inclusive.

FIELD HUSBANDRY

Climate

METEOROLOGICAL OBSERVATIONS

Data on temperature, precipitation and evaporation have been recorded at the Swift Current Experimental Station since its inception in 1922. A summary of these records is presented in Table 1.

An analysis of the records shows that January is the coldest month of the year, but the lowest recorded temperature of —55 degrees occurred on February 15, 1936. The hottest month is July with August ranking second. The highest temperature recorded is 103 degrees, which has occurred on three dates, June 23, 1941; July 17, 1936; and July 4, 1937.

The precipitation records show that the winter months from November to March, inclusive, are comparatively dry. After March, the monthly rainfall increases fairly rapidly, reaching a peak in June and then drops steadily until the end of the year.

Evaporation is highest in July, with August the next highest. The total evaporation from an open water surface during the five months, May to September, inclusive, is more than three times the rainfall for the months concerned.

Precipitation records have been kept at all the Substations since their inception. A summary of these records is presented in Table 2. It will be noted that the precipitation varies considerably from Station to Station. Carmichael shows the highest average precipitation, with 16·15 inches, and Fox Valley the lowest with 9·33 inches. Riverhurst is another Station showing a relatively low average precipitation with a total of 10·92 inches. With this wide variation in both monthly and annual precipitation, it can be readily realized that farming parctices, which are suitable for one area, are not necessarily suitable to other areas.

TABLE 1.—SUMMARY OF METEOROLOGICAL RECORDS
Dominion Experimental Station, Swift Current, Sask.
1922-1946 (25 years)

Month	Temperatures					Precipitation in Inches	Evaporation in Inches
	Minimum	Date	Maximum	Date	Mean		
January	—47	27, 1929 20, 1943	58	31, 1931	9	0·65	-
February	—55	15, 1936	60	27, 1932	13	0·46	-
March	—33	6, 1935	69	26, 1946	25	0·55	-
April	— 8	10, 1940	92	29, 1939	40	0·77	-
May	8	5, 1929 9, 1946	97	27, 1936	25	1·65	5·51
June	27	1, 1936	103	23, 1941	59	2·90	5·83
July	35	5, 1934	103	17, 1936 4, 1937	66	1·86	7·38
August	26	22, 1928	100	3, 1929 12, 1940	63	1·80	6·36
September	9	24, 1926 24, 1928	97	3, 1940	53	1·13	4·08
October	—15	29, 1935	90	3, 1943	42	0·72	-
November	—26	11, 1940 21, 1946	71	19, 1936	25	0·52	-
December	—39	26, 1924	70	5, 1939	14	0·47	-
Annual	-	-	-	-	38·5	13·48	29·16

Frost-Free Period

Table 3 presents the dates of the late spring and early fall frosts for the past 24 years. Great variations exist from year to year. The shortest frost-free period was in 1928 when only 75 days were without frost, and the highest was

in 1938 when 152 days were free of frost. The average since 1923 was 109 days. The last spring frost in 1944 occurred on May 3 and in 1942 on June 12. These are the earliest and latest dates during the 24-year period. The extreme dates for the fall frosts are August 7, 1927 and October 13, 1938.

In 14 years out of 25, freezing temperatures have been recorded after May 24. In 14 years out of 24, fall frosts occurred before September 15.

TABLE 2.—PRECIPITATION RECORDS

10-year Averages—1937-1946

Station	Fall	Winter	Summer				Summer Total	Crop Year Total	Calendar Year Total
	Aug. 1 to Oct. 31	Nov. 1 to Mar. 31	April	May	June	July			
Bracken	2·91	3·11	0·89	1·68	3·65	1·37	7·59	13·61	13·38
Carmichael	3·78	3·50	1·21	1·94	3·56	1·62	8·33	15·61	16·15
Fox Valley	2·43	2·07	0·38	0·99	2·42	0·75	4·54	9·04	9·33
Gravelbourg	2·88	2·60	0·91	1·82	2·90	1·83	7·46	12·94	13·22
Kincaid	3·56	2·21	0·94	1·66	3·60	1·97	8·17	13·94	14·16
Limerick	3·49	2·91	0·71	1·85	3·49	2·16	8·21	14·61	14·62
Riverhurst	2·22	2·21	0·63	1·59	2·33	1·53	6·08	10·51	10·92
Shackleton*	3·29	2·77	0·84	1·37	2·92	1·52	6·65	12·71	12·98
Shaunavon	2·98	1·86	0·64	1·51	3·09	1·58	6·82	11·66	12·03
Tompkins	3·45	3·30	0·95	1·49	2·91	1·54	6·89	13·64	13·92
Tugaske	2·51	3·60	0·60	1·90	3·30	1·79	7·59	13·70	14·10
Valjean	3·06	3·13	0·70	1·62	2·71	1·63	6·66	12·85	13·38
Swift Current	3·52	2·72	0·79	1·55	2·68	1·75	6·77	13·01	13·61
Average	3·08	2·77	0·78	1·61	3·04	1·62	7·05	12·90	13·21
Swift Current 25-year average (1922-1946)	3·59	2·61	0·77	1·65	2·90	1·86	7·18	13·38	13·48

* 8-year average.

Dates of Farm Operations

The data presented in Table 4 show the earliest, latest, and average dates of farm operations at this Station since 1931.

Variations in seasons have caused large differences in the dates at which farming operations could be performed. For example, the following extremes will be noted, commencing work on land March 21 to April 27, while date of starting to cut wheat varied from July 26 to August 24.

Crop Rotations

Several types of rotations have been tested at this Station to determine their relative merits for southwestern Saskatchewan. These include such rotations as continuous wheat, fallow and one grain crop, fallow and two grain crops, and rotations where grasses and legumes have been included.

The rotations, which included grasses and legumes, were from 5 to 7 years' duration. The hay crops were intended to occupy the land for one year in the case of sweet clover and from 2 to 3 years in the case of the grasses. It was found that it frequently requires two or more years to obtain satisfactory stands of grass. Consequently, if grasses are to be included in a rotation, it should be in such a manner that the grass is left over a period of years so that a good sod can be formed. Seeding of grasses in a short rotation is not recommended for this area.

An analysis of the data on the straight grain rotations shows that on the basis of a 10-year average the highest yields of wheat per cultivated acre have been obtained from continuous cropping as indicated in Table 5.

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

Dominion Experimental Station, Swift Current, Sask.
1923-1947 (24 years)

(Freezing temperature 32 degrees Fahrenheit or lower)

Year	Spring Frosts	Fall Frosts	Frost-Free Periods
	Date of Last Frost in Spring	Date of First Frost in Fall	Days Frost-Free
1923	May 17 (22°)	Sept. 9 (31°)	115
1924	June 4 (31°)	Sept. 12 (29°)	100
1925	May 15 (25°)	Sept. 20 (31°)	128
1926	May 31 (31°)	Sept. 11 (28°)	103
1927	May 17 (31°)	Aug. 7 (29°)	82
1928	June 8 (32°)	Aug. 22 (26°)	75
1929	June 3 (32°)	Sept. 3 (31°)	92
1930	May 26 (31°)	Aug. 31 (28°)	97
1931	May 21 (31°)	Sept. 16 (32°)	118
1932	May 27 (27°)	Sept. 15 (30°)	111
1933	June 10 (31°)	Sept. 24 (28°)	106
1934	May 22 (32°)	Aug. 22 (32°)	92
1935	June 3 (28°)	Aug. 25 (30°)	83
1936	June 3 (29°)	Sept. 13 (28°)	102
1937	June 5 (31°)	Aug. 28 (31°)	84
1938	May 14 (31°)	Oct. 13 (27°)	152
1939	May 11 (26°)	Sept. 6 (32°)	118
1940	May 13 (29°)	Oct. 5 (26°)	145
1941	May 9 (31°)	Sept. 20 (29°)	134
1942	June 12 (30°)	Sept. 22 (26°)	102
1943	June 3 (32°)	Sept. 8 (31°)	97
1944	May 3 (32°)	Sept. 18 (32°)	138
1945	May 28 (29°)	Sept. 17 (32°)	112
1946	May 19 (31°)	Aug. 31 (31°)	104
1947	May 27 (18°)	Sept. 23 (29°)	119
Average	May 25 (30°)	Sept. 11 (29°)	109

TABLE 4.—DATES OF FARM OPERATIONS

Dominion Experimental Station, Swift Current, Sask.
1931-1946 (16 years)

——	Earliest	Latest	Average
Commencing work on land	March 21, 1931	April 29, 1947	April 20
Seeding wheat	April 5, 1946	June 18, 1934	May 7
Seeding oats	April 5, 1946	July 10, 1934	May 1
Seeding barley	April 5, 1946	June 5, 1936	May 1
Seeding flax	April 28, 1944	May 30, 1942	May 14
Spring ploughing	April 3, 1933	June 4, 1945	April 30
Seeding corn	May 12, 1945	May 22, 1931	May 18
Planting potatoes	May 5, 1945	May 25, 1944	May 13
First operation on fallow	April 23, 1946	July 21, 1944	May 29
Cutting grass hay	June 6, 1931	Sept. 13, 1944	July 13
Cutting alfalfa (first cut)	July 2, 1942	July 9, 1940	July 5
Cutting alfalfa (second cut)	Aug. 5, 1942	Aug. 18, 1943	Aug. 11
Cutting fall rye	July 17, 1937	Aug. 20, 1942	Aug. 1
Cutting wheat	July 26, 1937	Oct. 10, 1944	Aug. 25
Cutting oats	July 31, 1945	Oct. 5, 1945	Aug. 16
Cutting barley	July 22, 1937	Oct. 9, 1945	Aug. 10
Cutting flax	Aug. 12, 1945	Oct. 20, 1942	Sept. 17
Cutting corn	Sept. 6, 1940	Sept. 17, 1944	Sept. 10
Harvesting potatoes	Sept. 23, 1940	Oct. 12, 1945	Sept. 30
Operating combine	Aug. 3, 1936	Oct. 20, 1944	Sept. 5
Threshing	Aug. 10, 1943	Oct. 30, 1943	Sept. 16
Fall work	Sept. 8, 1941	Oct. 21, 1942	Sept. 30
Date of freeze-up	Oct. 18, 1945	Dec. 19, 1939	Nov. 5

TABLE 5.—YIELD OF WHEAT PER ACRE IN VARIOUS ROTATIONS

10-Year Average 1938-47—Swift Current, Sask.

Rotation	Yield on Fallow	Yield on Stubble
	bu.	bu.
Continuous wheat	-	8·3
Fallow-wheat	13·6	-
Fallow-wheat-wheat	13·7	6·9
Fallow-wheat-oats	15·4	Oats 15·4
Fallow-wheat-barley	14·0	Barley 8·9

Under a system of continuous cropping, crop failures have been fairly frequent. However, in years of good moisture conditions, yields have compared favourably with those on fallow with the result that the average yield for continuous cropping has been maintained at a relatively high level.

Judging the various rotations on a basis of yields from individual years, it becomes apparent that there is no standard rotation which can be consistently followed if maximum returns from the land are to be obtained. A more practical solution to the problem appears to be to plan the cropping program on the basis of the depth of moisture in the soil at seeding time.

EFFECT OF DEPTH OF MOIST SOIL AT SEEDING TIME ON YIELDS OF WHEAT

During the past four years, experiments have been conducted at the Substations in southwestern Saskatchewan in connection with determining the effect of depth of moist soil at seeding time on subsequent yields of wheat.

The Substations cover a wide range of soil types and seasonal climatic conditions. Consequently, the results obtained from this work apply in a general way to all of southwestern Saskatchewan.

In order to determine the depth of moist soil, holes were bored with an auger at several points in the field. Care was taken to select areas which were fairly representative of the area involved. The soil was considered moist if it would stick together when pressed into a ball in the hands.

The dividing line between moist and dry soils is usually quite distinct in stubble land, but in fallow land the dividing line is sometimes difficult to determine accurately. Harvesting was done in the regular way and the average yield of the field was recorded. The results of this work are summarized in Tables 6 and 7.

Up to the time of writing, 72 records have been obtained; 45 of these were on fallow and 27 on stubble land. Although there are insufficient records as yet to draw any definite conclusions; the records available show some interesting trends.

In Table 6 comparisons are made between yields of wheat on fallow and stubble. It will be noted that when the depth of moist soil was the same in fallow and stubble the average yields obtained were approximately the same. This being the case, all the records can be combined to show the effect of depth of moist soil on crop yields, as is done in the last column. These records show that the average yield increased from 8·3 bushels per acre, when the depth of moist soil was 18 inches or less, to 20·4 bushels per acre when the depth of moist soil at seeding time was over 44 inches. The need for conserving all the moisture possible is quite evident.

TABLE 6.—EFFECT OF DEPTH OF MOIST SOIL AT SEEDING TIME ON YIELDS OF WHEAT

Substations Southwestern Saskatchewan (1944–1947, inclusive)

Depth of Moisture	Wheat on Fallow		Wheat on Stubble		Total Number of Records	Average Yield All Records
	Number of Records	Average Yield	Number of Records	Average Yield		
in.		bu.		bu.		bu.
0–18	5	7·2	14	8·7	19	8·3
18–25	9	9·6	7	8·4	16	9·1
25–35	8	12·4	4	12·4	12	12·4
35–44	14	17·3	1*	13·0	15	17·0
44+	9	20·4	1*	21·4	10	20·4

* Both these results were obtained on sandy loam soil.

TABLE 7.—EFFECT OF DEPTH OF MOIST SOIL ON THE FREQUENCY OF YIELDS WITHIN THE VARIOUS RANGES

Substations Southwestern Saskatchewan (1944-1947, inclusive)

Depth of Moisture	Yields in Bushels per Acre						
	0·0-4·9	5·0-9·9	10·0-14·9	15·0-19·9	20·0-24·9	25·0-29·9	30+
in.							
0–18	6	9	1	1	2	–	–
18–25	3	7	5	1	–	–	–
25–35	–	4	5	2	1	–	–
35–44	–	2	5	5	0	1	2
44+	–	1	2	1	2	3	1

Although seasonal rainfall is a very important factor in determining crop yields, it has not been considered in the above statements. Some idea of the variations in crop yields, due to such factors as seasonal climatic conditions and soil type, can be obtained from Table 7.

This table shows the number of times yields have been within the various ranges. For example, when the depth of moist soil was 18 inches or less at seeding time, 6 crops out of 19 yielded less than 5 bushels per acre; 9 crops between 5 and 10 bushels; 2 crops yielded between 10 and 20, and the remaining 2 between 20 and 25 bushels per acre. Similar fluctuations in yield occurred with the other moisture ranges. However, it will be noted that as the depth of moist soil at seeding time increased, the proportion of crops producing higher yields increased fairly rapidly. In other words, the chances of obtaining a crop appear to be proportional to the depth of moist soil at seeding time. This point is of particular importance in the seeding of stubble land. If the figures presented are any indication of what might be expected in the way of crop yields, one need only determine the depth of moist soil to obtain an idea of the chances of obtaining a paying crop.

Precipitation and Moisture Conservation

Precipitation records have been kept at the Experimental Station, Swift Current, Sask., since 1922 and at the substations since their inception in 1935. The average precipitation for the various points is tabulated in Table 8.

TABLE 8.—TEN-YEAR AVERAGE PRECIPITATION, 1937-1946

Substations Southwestern Saskatchewan

Station	Total Annual	Fall Aug. 1 to Oct. 1	Winter Oct. 1 to April 1	Summer April 1 to Aug. 1	Total Summer-fallow Period
	in.	in.	in.	in.	in.
Bracken	13·31	2·35	3·69	7·27	19·35
Carmichael	16·25	2·43	4·84	8·98	23·52
Fox Valley	9·33	1·70	2·77	4·86	13·80
Gravelbourg	13·50	2·14	3·39	7·97	19·03
Kincaid	14·44	2·41	3·43	8·60	20·28
Limerick	14·54	2·69	3·75	8·10	20·98
Riverhurst	11·00	1·43	3·10	6·47	15·53
Shackleton[1]	12·64	1·93	3·67	7·04	18·24
Shaunavon	12·21	1·79	2·95	7·47	16·95
Tompkins	14·01	2·26	4·32	7·43	20·59
Tugaske	14·13	2·01	4·36	7·76	20·50
Valjean	13·33	1·97	4·17	7·19	19·47
Swift Current[2]	13·48	2·93	3·37	7·18	19·78

[1] 7-year average.

[2] 25-year average.

Although there are not sufficient recording points to establish any pattern of precipitation in southwestern Saskatchewan, the figures available do show that there is considerable variation in the average annual and seasonal precipitation at the various stations. Fox Valley, with an average annual rainfall of 9·33 inches and a seasonal rainfall of 4·86 inches, has the lowest precipitation of any of the Substations. On the other hand, the highest average precipitation recorded at the Substations is on the bench of the Cypress Hills, south of Carmichael, with an average annual rainfall of 16·25 inches and a seasonal rainfall of 8·98 inches.

Precipitation during the summerfallow period, which is considered as starting August 1 and extending to April 1 twenty months later, shows a range of from 13·80 inches at Fox Valley to 23·52 inches at Carmichael.

Table 9 shows the average depth one inch of water will penetrate in various soil types. In comparing the table with the average precipitation during the summerfallow period, it is evident that if half of the moisture that fell could be conserved there would be sufficient, in most cases, to saturate the soil to a depth of over four feet during each summerfallow period.

TABLE 9.—*AVERAGE DEPTH ONE INCH OF WATER WILL PENETRATE ON VARIOUS SOIL TYPES

Sandy loam	11·4 inches
Loam	6·6 "
Clay loam	5·4 "
Clay	4·6 "

* Figures obtained from Report of Soils Research Laboratory, Swift Current.

It would appear, therefore, that the problem of conserving moisture in this area is not so much a lack of rainfall but rather of conserving a greater proportion of the precipitation.

Precipitation, as far as the soil in this area is concerned, is lost in three ways, namely, run-off, evaporation, and plant growth. (In a few cases some moisture may be lost by percolation). The first two vary considerably with the nature of the precipitation and soil type, as well as numerous other factors. The extent to which this loss can be controlled is rather limited. The third factor, plant growth, can be controlled in most cases by cultural methods. Fall precipitation is frequently lost as a result of weed growth in the stubble after harvest. Winter precipitation may be lost due to delay in starting fallow operations. Summer moisture may be lost by allowing volunteer grain and weeds to grow on the fallow during the fall. It is quite apparent, therefore, that in order to conserve the greatest possible amount of moisture, it is absolutely essential that weeds be kept under control from the time one crop is harvested until the next crop is seeded.

An experiment to determine the effect of date of starting fallow operations on the depth of moisture conserved was started at the Swift Current Experimental Station in 1946. The results obtained in 1947 are presented in Table 10.

TABLE 10.—EFFECT OF DATE OF STARTING FALLOW OPERATIONS ON DEPTH OF MOIST SOIL

Swift Current Experimental Station—1947

Date of Starting Fallow Operations	Number of Operations Required	Depth of Moisture Spring 1947	Depth of Moisture Late Fall 1947	*Cost of Operations
		in.	in.	$
May 18	5	24	36	2·35
May 30	5	24	27	2·35
June 15	4	24	24	1·89
June 30	3	24	21	1·53
1947 wheat stubble	0	-	14	-

* Figures based on the average cost of operating individual machines at the Swift Current Experimental Station during 1947, and includes labour, gas, etc.

The depth of moisture in the stubble previous to starting any fallow operations was 24 inches. Fallow operations were started on the dates indicated. Subsequent tillage was such as to keep weeds in check at all times. It will be noted that the earlier fallow operations were started, the greater was the amount of moisture conserved. Where the first operation was delayed until June 15, no additional moisture was conserved during the summer, while a delay in the first operation to June 30 actually resulted in a loss.

It will also be noted that over half of the moisture conserved was present previous to starting fallow operations. Similar results were obtained at the Substations in 1947. The results are further supported by work done by the Soil Research Laboratory, which showed that on the average of a four-year period over 50 per cent of the moisture conserved in fallow, under field conditions, was present previous to starting fallow operations in the spring. Hence, the importance of starting fallow operations before the weeds have an opportunity of removing this moisture from the soil.

Records on the cost of operations show that the extra tillage required for a good fallow as compared with a poor one can be done at a relatively small increase

in cost. When it is realized that the additional moisture conserved by the extra tillage can mean an increase of 6 to 9, or more, bushels per acre of wheat the following year, then it becomes apparent that the additional expense in working the fallow is a sound investment.

There appears to be a general opinion that extra tillage to conserve moisture will lead to excessive soil drifting. This is not necessarily the case. Some of the most serious soil drifting has occurred on fields that have been worked only once when the land was dried out by a heavy growth of weeds.

On the other hand, there are numerous reports on fields which have been worked five or more times without any soil drifting. The problem of soil drifting control does not depend so much on the number of operations as it does on the kind and quality of the work done.

EFFECT OF DATE OF SEEDING ON THE YIELD OF WHEAT, OATS, AND BARLEY

An experiment to determine the effect of date of seeding on yields of wheat, oats, and barley was started at the Swift Current Station in 1933. In the original experiment, wheat, oats, and barley were seeded on fallow as early as possible each year and further seedings were made at 10-day intervals. In 1939, the experiment was enlarged to include seedings of all three crops on stubble at the same dates. In 1946, the experiment was further revised so that all dates of seeding except the first would come on fixed dates, namely, the first date to be as early as possible and further seedings to be made on May 1, 10, 18 and 26 in the case of wheat and on the first four dates mentioned for oats and barley.

During the course of this experiment, the first date of seeding has varied considerably as indicated in Table 11. The earliest seeding was on April 5, 1946, and the latest date to start seeding was May 2, 1935. The average date of starting seeding was April 21 and 22.

TABLE 11.—DATES OF STARTING SEEDING AT SWIFT CURRENT, SASK.—1933-1947

1933.....April 29	1938.....April 21	1943.....April 21
1934.....April 21	1939.....April 20	1944.....April 19
1935.....May 2	1940.....May 1	1945.....April 20
1936.....April 30	1941.....April 9	1946.....April 5
1937.....April 19	1942.....April 16	1947.....April 30

Average date April 21–22.

TABLE 12.—EFFECT OF DATE OF SEEDING ON RELATIVE YIELDS OF WHEAT, OATS, AND BARLEY ON FALLOW

13-Year Average

Date of Seeding	Bushels per Acre			Pounds per Acre		
	Wheat	Oats	Barley	Wheat	Oats	Barley
Early as possible	16·0	39·9	27·7	960	1,357	1,320
May 1	16·9	40·0	27·1	1,014	1,360	1,301
May 10	17·0	40·0	27·1	1,020	1,360	1,301
May 18–20	16·2	32·4	21·4	972	1,102	1,027

In checking over the date of starting seeding, it will be noticed that with the exception of 1941 and 1946 the first date of seeding was either around April 20 or May 1. Consequently, the dates of seeding used in the earlier years coincide fairly closely with the dates being used at the present time.

The results of this work are summarized in Tables 12 and 13.

TABLE 13.—EFFECT OF DATE OF SEEDING ON RELATIVE YIELDS OF WHEAT, OATS, AND BARLEY ON STUBBLE

8-Year Average

Date of Seeding	Bushels per Acre			Pounds per Acre		
	Wheat	Oats	Barley	Wheat	Oats	Barley
Early as possible	12·8	34·1	21·0	768	1,129	1,008
May 1	13·9	32·0	23·0	834	1,088	1,104
May 10	14·2	31·1	22·7	852	1,057	1,090
May 18-20	14·2	23·0	18·8	852	782	902

During the 15 years of this experiment, the earlier seedings have been damaged by frost in three years, namely, 1942, 1946, and 1947. The damage was exceptionally heavy on oats in 1946 and on barley in 1942 and 1946. Damage to wheat was not so severe as to the other two crops. The heavy frosts of 1947 did not materially reduce the yield of the early sown crop as compared with the seedings made at a later date.

The records show that on the average wheat on fallow has produced the highest yields when seeded any time from May 1 to 10, and on stubble between May 10 and 20. Seedings have been made after May 20, but in all cases the yields have been reduced to a considerable extent.

In the case of oats, the figures show that the average yield is approximately the same on fallow for the first three dates of seeding. However, if the yields in 1946, when the early crop was badly frozen, are omitted then the early seeding shows a definite advantage. On stubble land, the early seeding has definitely produced higher yields in spite of the frost damage in 1946.

With barley, the results show that the earliest seeding on fallow has produced the highest yield in spite of the fact that the crop suffered severely from frost in two years. On stubble, the severe frost in the spring of 1946 reduced the yield to such an extent that the average yield of the early seeding is lower than the two subsequent seedings. Here again, if this one year's results are omitted, the yields would show a definite advantage for early seeding.

On the basis of these results, it is recommended that oats and barley should be seeded previous to May 1, wheat on fallow from May 1 to 10, and wheat on stubble from May 10 to 20.

Regarding the effect of date of seeding on the relative yields of wheat, oats, and barley, it will be noted that on a basis of pounds per acre oats have outyielded barley slightly on fallow at all dates, and both oats and barley have outyielded wheat by a considerable margin. However, the difference is much more marked in the earlier seedings. On stubble land, barley has outyielded oats in all but the first seeding and has outyielded wheat by a considerable margin, particularly in the earlier seedings. Oats have outyielded wheat by a considerable margin in the earlier seedings but not in the seeding of May 18 to 20.

Records obtained at the Substations in southwestern Saskatchewan over a period of years, as tabulated in Table 14, show somewhat the same results as those obtained at Swift Current. The relative yields of these three crops vary

somewhat from station to station. In general, however, it can be stated that barley has outyielded wheat, in pounds per acre, at all points except Bracken. Oats have outyielded wheat at all points except Bracken, Fox Valley, and Tompkins.

TABLE 14.—RELATIVE YIELDS OF WHEAT, OATS, AND BARLEY ON FALLOW

Substations Southwestern Saskatchewan—1938-1947

Station	Number of Years Tested	Yield in Bu./Acre			Yield in Lb./Acre		
		Wheat	Oats	Barley	Wheat	Oats	Barley
Bracken	9	16·2	27·0	20·0	972	925	960
Carmichael	9	19·7	38·7	26·2	1,182	1,316	1,258
Fox Valley	9	15·2	26·7	23·8	912	908	1,142
Gravelbourg	8	23·4	52·1	35·6	1,404	1,771	1,709
Kincaid	7	23·8	59·4	35·7	1,428	2,020	1,714
Limerick	8	17·8	42·2	31·3	1,068	1,435	1,502
Pambrun	2	9·4	20·0	17·0	564	680	816
Riverhurst	5	15·4	33·9	26·1	924	1,153	1,253
Shackleton	7	19·0	36·4	31·0	1,140	1,238	1,488
Shaunavon	7	18·4	36·0	30·4	1,104	1,224	1,459
Tompkins	5	15·2	23·4	22·6	912	796	1,085
Tugaske	11	22·9	48·3	38·5	1,374	1,642	1,848
Valjean	5	12·1	25·8	27·0	726	877	1,296

The relative yields of oats and barley vary somewhat from station to station. At three stations, Carmichael, Kincaid, and Gravelbourg, oats have outyielded barley but at the other 10 stations barley has outyielded oats. Since the yields of oats and barley, relative to wheat and to each other vary considerably from station to station, it is difficult to make any specific recommendations. The figures therefore, should be used as a guide as to what may be expected in the way of yields per acre in the various localities and various soil types.

Flax Production

Flax has been an uncertain crop in this area. Due to its inability to compete with weeds, particularly Russian thistle, failures have been frequent. It is noteworthy that flax on fallow has often been more weedy than flax on clean stubble. As a result, yields on stubble frequently have been as high and, in some cases, higher than on fallow land.

Flax stubble is generally short and open and thus is not capable of holding any great depth of snow during the winter. Moisture conditions in this kind of stubble have been found in many cases to be less favourable than in stubble from other crops. Crops after flax, therefore, do not stand as good a chance. This probably accounts for some of the poor crops which have been obtained after growing flax.

Fall Rye Production

Fall rye has been grown on both fallow and stubble land for a number of years. There has been some winter-killing practically every year. This type of damage has been more severe on fallow land than on stubble, and at times has caused a complete failure of the crop. In years when winter-killing is not a serious factor, yields on fallow have been higher than on stubble. General observation would indicate that winter-killing is more severe on the heavier soils than on the sandy soils.

Although fall rye can apparently be seeded any time up until freeze-up, the highest average yields have been obtained by seeding about September 1. In years when grasshoppers are numerous, seeding should be delayed, otherwise this pest will cause serious damage.

Summerfallow Substitutes

The problem of finding a suitable substitute for summerfallow, so as to avoid the bare fallow, has been under investigation for a period of 20 years. The following crops have been used as substitutes: corn, potatoes, grain in rows, fall rye, sweet clover, early seeded oats and barley cut for hay on July 1 and the land fallowed the remainder of the year, and summerfallowing land until July 1 and then seeding oats and barley.

Growing of potatoes and grain in rows was discontinued in 1937. Potato growing on a large scale was found impractical in this area. Growing grain in rows is not recommended, as it is practically impossible to control the weeds between the rows with ordinary farm implements.

Results obtained from the substitute and the yields of wheat following the substitutes are presented in Table 15.

TABLE 15.—YIELDS OF SUBSTITUTE AND WHEAT FOLLOWING SUBSTITUTE

Fallow Substitute	10-Year Average Yield of Substitute	10-Year Average Yield of Wheat
	1937-46	1938-47
Fallow (check)	-	16·5 bu.
Cover crop	-	15·2 "
Early barley	0·72 tons	13·9 "
Early oats	0·70 "	13·6 "
Corn	0·82 "	13·4 "
Fall rye	1·9 bu.	12·4 "
Late barley	0·85 tons	12·2 "
Late oats	0·93 "	11·1 "
Wheat	7·0 bu.	9·4 "

In comparing the yields following the various substitutes, it will be noted that the yields were reduced fairly well in proportion to the extent of growth obtained and the protection from soil drifting provided by the substitute. Although the yields following cover crops compare favourably with those on fallow, it should be pointed out that in a number of years the cover crop germinated poorly and provided little protection from soil drifting. In years when the cover crop made good growth yields were decreased considerably more than average.

The yields following the early- and late-seeded oats and barley show the extent to which yields on fallow are reduced when any green growth is allowed to remain on land to be fallowed.

Since the yield of the following crop is reduced fairly well in proportion to the growth made by the fallow substitute, it must be concluded that there is no satisfactory substitute for fallow in this area.

Summerfallow Treatments

The main object in summerfallowing in this area is to conserve moisture. Evaporation may rapidly deplete soil moisture in the upper 4 or 5 inches, but moisture stored below that level is well protected and will be retained unless removed from the soil by plant growth. It is apparent, therefore, that the most essential feature in conserving moisture is to prevent weed growth from becoming established. Weeds are most easily destroyed when they are quite small, and one of the most effective means of keeping them in check is a light

tillage early in the season. Further tillage should be carried out as required to keep the weeds in check. Although tillage operations are mostly performed to destroy weeds, the effect on the soil in relation to soil drifting must always be considered.

The efficiency of various tillage machines in destroying weeds and at the same time leaving the soil in a condition to resist soil drifting depends upon a number of factors such as type of soil, amount and kind of stubble, moisture content of the soil, and the kind and amount of weed growth. With the exception of soil type, the above factors are all variable and, in some cases, may vary from day to day and certainly from field to field. It is apparent, therefore, that there is no standard method which can be followed year after year, or even from one field to another. The type of tillage required at any given time must be judged on the basis of the prevailing conditions.

When stubble is light and the soil relatively dry, the duckfoot cultivator or blade weeder has been found to be the most satisfactory implement for the first operation. Although the duck-foot cultivator will not clear as much trash as the blade weeder, it will work under a much wider range of moisture conditions and can frequently be used in cases where the blade will not scour.

If the soil is too moist for the cultivator, the disk harrow is the next best implement. Working light stubble with a one-way disk has a tendency to bury all the trash. Subsequent operations under the above stated conditions are usually most satisfactorily done with blade- or rod-type implements such as the duck-foot cultivator, blade weeder and rod weeder.

Under conditions of a heavy stubble or a heavy weed growth, especially stinkweed, the one-way disk has been found to be the most efficient implement to use. Subsequent operations depend entirely on the condition of the soil and the amount of weed growth at the time of such operations. If the soil is wet, it is almost essential to use a disk type of implement; if dry, the blade or rod types of implements can frequently be used to good advantage.

From the work done with the various implements under a wide range of conditions, it would appear that there is a definite place for two types of implements on every farm, the disk or rolling type and the blade or cultivator type. In the latter case, a machine half way between a blade weeder and a duck-foot cultivator, with some redesigning of the shovels to facilitate scouring more readily, would appear to be desirable.

Preparing and Seeding Stubble Land

The general practice at the present time is to seed only on fallow land. However, there still is a considerable acreage being seeded on stubble. In years when there is a good depth of moisture in the stubble, it would appear to be sound practice to seed the land rather than fallow but, if reserve moisture is low in the stubble, the chances of obtaining a crop are small. Consequently, before seeding stubble it would be advisable to determine the depth of moisture in the soil previous to seeding and to base the cropping plan on the results obtained. If the moisture is down two feet or more, it can be considered as a fair-to-good reserve. If less than 18 inches, the reserve moisture is low.

Various methods of preparing and seeding stubble land have been tested at this Station during the past 11 years. The methods used and the results obtained are presented in Table 16.

The results indicate that seeding with the one-way disk with seeder attachment has given the best results. In using this implement, however, it is very important that the seeding mechanism be set so the seed is placed on the firm ground at the bottom of the furrow, and that the depth of seeding be such

as to seed as shallow as possible and still cut all the surface of the ground. Unless these precautions are taken, poor results may be obtained by seeding with the one-way seeder.

TABLE 16.—STUBBLE TREATMENTS

11-Year Average

Yield in Bushels per Acre—1937–47

Treatment	Average Yield
Seed with one-way disk	14·2
Plough, pack and seed	14·0
Cultivate, seed	13·1
One-way disk, seed with drill	12·4

The plough makes a good job of killing weeds and, if the ploughing is well done, the crop is generally fairly clean. However, if there is much stubble turned under, the land remains loose and dries out rapidly. The stubble also makes it difficult for the drill to place the seed into firm ground.

Using a drill after one-way disking is subject to the same difficulties as after ploughing. The problem of penetrating the soil with the drill is aggravated by the fact that a considerable portion of the stubble remains on the surface.

The duck-foot cultivator will make a reasonably good job if the soil is dry and the stubble light. In many cases, the soil is wet at this season of the year and as a result the weeds are not all killed. Crops in general are more weedy and this reduces the yield.

Commercial Fertilizers

Tests of fertilizers have been conducted at this Station and at the Substations for a period of years. The results of this experiment at Swift Current are presented in Table 17.

TABLE 17.—AVERAGE YIELD OF WHEAT WITH AND WITHOUT FERTILIZER

9-Year Average, 1939–1947

Swift Current Experimental Station

Fertilizer	Rate Lb. Per Acre	Average Yield Bu./Acre	Increase Over Check (Bu.)
Check	-	16·1	-
Manure	10–12 tons	17·1	1·0
Triple superphosphate (0–43–0)	25 lb.	16·5	0·4
Complete fertilizer (9–27–9)	35 "	16·1	0·0
Ammonium phosphate (2–20)	35 "	15·9	−0·2
Ammonium phosphate (11–48)	35 "	15·9	−0·2
Ammonium sulphate 21% N	25 "	15·3	−0·8

It will be noted that none of the commercial fertilizers increased the yield sufficiently to pay for the expense involved. Manure produced the greatest increase in yield, but this was only one bushel per acre.

Triple superphosphate, applied at 25 pounds per acre, was tested at the Substations. The results are shown in Table 18.

TABLE 18.—AVERAGE YIELD OF WHEAT WITH AND WITHOUT FERTILIZER

Substations—Southwestern Saskatchewan

Station	Number of Years Tested	Average Yield—Bu./Acre		Increase Over Check
		Check	Fertilizer	
Carmichael	8	15·9	17·6	1·7
Fox Valley	4	15·0	15·0	0·0
Gravelbourg	4	15·5	15·8	0·3
Kincaid	5	21·3	22·2	0·9
Limerick	5	11·7	10·1	−1·6
Riverhurst	6	8·8	9·4	0·6
Shackleton	4	22·4	25·6	3·2
Tugaske	8	21·2	22·0	0·8

The results, with the exception of Shackleton, show very little increase from the use of fertilizer. The results at Shackleton were obtained under very favourable moisture conditions, as indicated by the high average yield. Since the results at the Substations follow similar lines to those obtained at Swift Current, it must be concluded that fertilizers cannot be recommended for southwestern Saskatchewan at the present time.

2,4-D Experiments

Preliminary experiments with 2,4-D were undertaken at this Station during the summer of 1947. These included both the effect on grain crops and the use of the chemical as a substitute for tillage. The rates of chemical used were one-quarter and one-half pound acid equivalent per acre on grain crops, and up to 1½ pounds acid equivalent per acre on fields being summerfallowed.

Applying 2,4-D previous to emergence of wheat and flax did not appear to cause any noticeable damage to the crop. Spraying wheat, oats, and barley in the seedling stage, however, that is when the crop was from 3 to 4 inches high, caused some damage. All crops were delayed somewhat in maturity and stands of grain were somewhat thinner than the check plots. Deformed heads were quite numerous in both wheat and barley. With oats, it caused a considerable number of blasted spikelets. Wheat sprayed when the crop was about 6 inches high did not show any apparent damage.

Flax sprayed in the early stages of growth was badly damaged, especially with the one-half pound rate of application. Flax sprayed in the pre-bud stage was set back about 10 days to two weeks. The crop branched out more than ever and, aside from being later in maturing, appeared quite normal.

In controlling such weeds as stinkweed and mustard in the growing crop, 2,4-D was found to be quite effective. Russian thistle, which is the predominant weed in this area, showed about the same resistance as flax. Very small plants were destroyed, but this plant built up resistance to the chemical quite rapidly.

It was also noticed that there was no apparent residual effect so far as Russian thistle is concerned, because a new crop of this weed appeared shortly after spraying. The final result was that there was a reduction in the number of Russian thistles present, but the weeds which were not destroyed produced larger plants due to less competition with other weeds. The primary object of tillage in this area is to control weeds. Since 2,4-D is a selective herbicide, its action is such that it will only destroy susceptible weeds. In using the chemical as a substitute for tillage, it was found that by removing the susceptible weeds the more resistant weeds were given an opportunity to flourish. It was necessary, in all cases, to resort to tillage to keep the land free of weeds so as to conserve moisture. General observation indicated that a good tillage operation was more effective in keeping down weeds than spraying with 2,4-D under the conditions at this Station. In view of the fact that the cost of the chemical required per acre is considerably higher than a tillage operation, and that the chemical only kills susceptible weeds, it cannot be considered as a satisfactory substitute for tillage.

Sawfly Experiments

Sawfly-control experiments have been conducted at the Substations every year since 1939. During this period many methods, including all the recommended practices, have been tested. With the exception of growing only sawfly-resistant or immune crops, none of the methods tried has proved entirely satisfactory. Attempts made to control sawflies on the individual farm without the co-operation of the neighbours, especially in areas of severe infestation, did not prove satisfactory. Where sawfly control was undertaken on a community basis, with the whole-hearted co-operation of each farmer, beneficial results have been obtained.

The eventual solution to the sawfly problem is the production and distribution of a satisfactory sawfly-resistant wheat. In the meantime, however, community action is essential to reduce the damage caused by the sawfly. For this purpose the following practices have been found the most practical:—

1. Trap the sawflies at the source of infestation. This can be partially accomplished by seeding a strip of wheat early, two or three rods wide, around all the previous year's wheat stubble. When stubble fields are large, additional traps should be seeded at about 20-rod intervals. These traps may be cut for hay, but in any case the land should be worked down for fallow as soon as the sawfly flight is completed.
2. Protect the wheat crop sown on fallow from invasion. Seed a strip of wheat early, four rods wide or wider, around all fallow fields to be sown to wheat. This trap should be sown on the fallow. The trap can be left for grain, but should be cut with a binder or swather as soon as the grain is in the firm dough stage. Work the land in this trap, shallow, as soon as possible after harvesting.
3. Delay the seeding of the main wheat crop as long as practicable so that the trap crop will be considerably more advanced than the main wheat crop.
4. The land to be fallowed should all be worked shallow before the end of May so as to expose the sawfly grubs at the surface.

If these four recommendations are carried out on a community basis, the damage from sawfly can be considerably reduced.

Reclamation of Badly Drifted Areas

Experimental work on the reclamation of badly drifted land was undertaken during the period 1935 to 1940. For this purpose four areas were selected, namely, Cadillac, Mortlach, Meyronne and Vanguard. In each of these areas a large acreage of land was in a badly drifted condition, and was a serious menace to adjoining farm land.

The purpose of these experiments was to determine, if possible, the most efficient and economical means of reclaiming badly drifted land. Factors which were studied include type of implements, condition of the land, time of year to do the work, and the kind of crop most suitable for this purpose.

The implements tested included the duck-foot cultivator and drill, one-way disk with seeder box, deep furrow drill, Dempster drill, shovel-type lister seeder and the mouldboard-type lister with seeder attachment. It was found that the type of implement that gave the most satisfactory results depended to a large extent on the condition of the land. In areas where the sub-surface soil was exposed, any implement which would penetrate the soil and leave the land in a cloddy condition was quite satisfactory. Deep ridging under these conditions was not necessary or desirable, as it left the land in too ridged a condition for seeding to grass after the drifting was controlled. Areas having a deep accumulation of drift soil created an entirely different problem. The only means of preventing drifting under these conditions was by means of deep furrows. It was found, however, that listing furrows at fairly close intervals was more effective than solid listing. Hence the most satisfactory method for this condition appeared to be to alternate the ordinary grain drill with a lister with seeder attachment.

The success or failure of reclaiming badly drifted land is to a considerable extent dependent upon climatic conditions, particularly wind velocity, from the time the land is seeded until the crop is established sufficiently to protect the soil. Hence it is very important that the work be done during a period when growth is rapid. An analysis of the results of the work done at various times of the year indicates that the most suitable time is approximately between June 1 and July 10.

An experiment on the relative merits of various crops for controlling soil drifting was undertaken at Mortlach in June, 1937. The crops tested consisted of corn and sunflowers in one-, two-, and three-foot rows; wheat, barley, sudan grass, millet and spring and fall rye. The results indicate that sunflowers, sudan grass and millets are very subject to damage from drifting soil. Corn is rather slow starting and must be seeded in rows close together to be effective. Wheat is slightly more resistant to damage from drifting soil than barley or rye. Rye, however, produces a more rapid growth and a heavier stand of straw on the sandy land, and in addition volunteers quite readily, and for these reasons is the most satisfactory crop for reclamation work in this area. Spring rye is preferred to fall rye, particularly if the crop is seeded during the first part of June. This gives the rye a chance to mature a crop the year it is seeded. If seeding is delayed until late June or early July, fall rye has been found more satisfactory. In the latter case, it was necessary to fence the area in order to prevent livestock from grazing the crops in the fall and winter and thus exposing the land to drifting.

Once a good stand of rye has been obtained and the drifting is controlled, the land should be seeded to grass for pasture or hay purposes. Cultivation of such land. after it has been reclaimed, is quite liable to lead to a recurrence of serious soil drifting within a very short space of time.

CEREALS

Introduction

Spring wheat is the most important cereal crop produced in southwestern Saskatchewan. The climate and soils of this area are particularly suitable for the production of wheat that is high in baking strength. Such wheats command a premium on the world market because of their suitability for mixing with wheats of lesser strength. In addition to wheat, large acreages are devoted

annually to the production of barley, flax, spring and fall rye, and oats. All these crops receive consideration in the cereal improvement program carried on at this Station. More attention, however, is paid to wheat because of the greater importance of this crop.

The cereal improvement program consists of the importing and testing of varieties and hybrid lines from all parts of the world; studies on drought, insect and disease resistance; the breeding of new varieties; and the extensive testing of promising new material at various points throughout southwestern Saskatchewan.

The Importation of Varieties

Since the inception of the Station approximately 1,300 varieties of wheat, 125 of winter wheat, 750 of barley, 650 of oats, 150 of flax, and 50 of rye have been imported and tested. These have come from practically all countries in the world. The object is to obtain all new varieties wherever produced and to test them under local conditions. In this program, particular attention is paid to varieties produced at other institutions in Western Canada and in the neighbouring States of Minnesota, North and South Dakota, and Montana. Varieties from these points are most likely to be valuable in southwestern Saskatchewan.

The great majority of the varieties imported have no value whatsoever. Occasionally one is found to be particularly suitable to this area, for example, Thatcher wheat. This variety originated in Minnesota. Other varieties may have one valuable characteristic that makes them particularly valuable for use in a breeding program. For example, certain solid stemmed wheats were imported from New Zealand to Swift Current. These wheats were inferior to Canadian varieties in most respects, but they were resistant to wheat-stem sawfly. They became the basis of the breeding program to produce sawfly-resistant wheats that will be described later in this report. These are but two examples of important results that have accrued from the importing and testing of varieties from other countries. Many more could be cited.

Studies on Drought Resistance

Drought is the major limiting factor in crop production in this area. Attempts are constantly being made to find varieties more drought resistant than those now available. Drought is difficult to study in the field. It may be so severe that all varieties fail, or it may not be sufficiently severe to differentiate between resistant and susceptible varieties. Consequently, most of the work must be done in the greenhouse where the moisture supply can be carefully controlled.

The principal objective of the investigations conducted has been to determine some relatively simple method whereby drought-resistant plants can be differentiated from drought-susceptible ones. If such a method could be found, it would then be possible to quickly classify thousands of varieties. The most resistant types could then be used directly by growers, or they could be further improved by inter-crossing and selection.

In one investigation, an attempt was made to find any characteristics that could be seen with the eye, unaided or with a microscope, that would be associated with drought resistance. A series of wheat varieties were grown in the field under natural conditions and in the greenhouse under carefully controlled conditions. The morphological characteristics of each variety, the cell size, and the number and size of the stomata were studied. The more drought resistant types tended to have smaller and more numerous stomata than the susceptible types, but there were so many exceptions that this method of studying drought resistance has little practical value. The other characters studied appeared to have no relation to drought resistance.

In another investigation, the recovery of wheat varieties after exposure to severe wilting was studied. A series of varieties were grown in closed containers filled with well mixed soil. The soil surface was sealed so that the only moisture removed from the soil was that used by the plants. Each variety received exactly the same amount of moisture. After the plants were well established, no further moisture was added until the plants were dry and brittle. Additional moisture was then added and the number of plants of each variety recovering was noted. Some varieties recovered to a much greater extent than others and, in general, the results were in agreement with field observations. This method holds promise as a method of rapidly determining the relative drought resistance of different varieties.

In the above experiment it was found that there was no difference between varieties in the amount of moisture they removed from the soil. This is in agreement with the work of many other investigators. Thus, it would appear that a drought-resistant variety utilizes the moisture it receives to better advantage than a susceptible one, and is better able to recover when rains fall after a period of drought.

Studies on Insect Resistance

Studies on the resistance of wheat varieties to wheat-stem sawfly damage have been carried on at this Station for many years. The work has been conducted in co-operation with the Dominion Entomological Laboratory at Lethbridge, Alta. Many different wheat varieties from all parts of the world have been tested. All varities of hollow-stemmed wheat have been susceptible to damage. Solid-stemmed wheats have varied in reaction from highly resistant to moderately susceptible. Seasonal conditions have influenced the amount of damage sustained by both resistant and susceptible types. Susceptible types suffered most damage under average growing conditions and least when subjected to heavy rainfall or severe drought. Resistant types were most severely damaged when subjected to wet, dull weather during the period of stem elongation. Greater than normal damage to resistant types has also occurred from time to time, but the conditions responsible for this are not yet fully understood.

All durum varieties have shown high sawfly resistance in wet years. In dry years, the reaction has varied from high resistance to moderate susceptibility. In all tests, however, the most susceptible durums have been much more resistant than the commonly grown bread wheats. One durum variety, Golden Ball, has been highly resistant to all tests.

The reaction of barley varieties to sawfly damage has also been studied. The results showed that varieties differ in the damage they sustain, but none of the varieties was as susceptible as the common wheats. Prospect, Titan, and Plush were among the highly resistant types, while Hannchen was moderately susceptible.

Grasshoppers are often a serious pest of cereal crops in southwestern Saskatchewan. The fact that they feed more freely on some crops and varieties led to a series of experiments started in 1944. These tests have been confined to barley varieties since there is a wider range of damage in this crop. Many varieties and hybrids were exposed to natural infestations of grasshoppers during the past four years. While such tests indicate preference rather than resistance, it may be stated that, in general, the early maturing varieties suffer less damage than do the late maturing varieties. While this relationship is generally true, there is evidence to show that the susceptibility of barley varieties to grasshopper attack cannot be explained solely on the basis of maturity. Further tests are required before the exact reason for such varietal differences is known. Of the more commonly grown varieties, Prospect, Titan, Compana, and Warrior are damaged less than are O.A.C. 21, Hannchen, Rex, Regal, and Plush.

Studies on Disease Resistance

The purpose of this study is to determine the resistance or susceptibility of cereal varieties to the more common diseases prevalent in this area. In wheat, particular attention is devoted to common root-rot, bunt, and stem rust; in barley to common root-rot and loose and covered smut; and in oats to stem rust and the oat smuts. These studies are carried on in close co-operation with the Dominion Laboratory of Cereal Breeding, Winnipeg, and the Dominion Laboratories of Plant Pathology at Saskatoon and Winnipeg.

In these tests the varieties are inoculated with the organism causing the disease, and only those having a high degree of resistance escape damage. The results obtained with the commonly grown varieties are presented in the discussion of these, which follows in a later section.

Cereal Plant Breeding

The objective of the breeding program is to incorporate into locally adapted varieties those desirable characteristics that are found in the studies on drought, insect and disease resistance. The ultimate aim is to produce varieties that have resistance to all these factors.

SPRING WHEAT

The immediate goal of the wheat breeding program has been the production of a sawfly-resistant variety that would be satisfactory in all other respects. This has been partially accomplished with the production of the new variety, Rescue, in the spring of 1946. This wheat is resistant to sawfly attack, high yielding and resistant to stem rust. It is, however, susceptible to bunt, only moderately resistant to root-rot, and somewhat weak strawed. The breeding program is now being concentrated on improving the defects of this variety.

BARLEY

The objective of the barley breeding program is the production of early maturing, high yielding feed barleys resistant to disease and suitable for combine harvesting. In 1938, the variety Prospect was released for commercial production. This variety is smooth-awned, early, high yielding, and reasonably satisfactory for combine harvesting, but is susceptible to loose and covered smut and, under some conditions, shatters rather freely. Prospect achieved immediate popularity and was grown almost to the exclusion of all other varieties in southwestern Saskatchewan for many years. In the present breeding program a number of lines have been produced from the cross Titan $\times$ Glacier that are less prone to shatter and much more resistant to both smuts than Prospect. Their yielding ability has not been fully evaluated as yet.

OATS

Oats occupy a minor place in the breeding program. Efforts have been concentrated on improving yield, bushel weight, and hull percentage. While lines have been produced that are better than existing varieties in these respects, they are unsatisfactory in disease reaction, and further work will be necessary before one of them can be released for commercial production.

Varietal Tests

Varieties introduced from other institutions and the hundreds of hybrid lines produced in the breeding program must be carefully tested before they can be recommended for commercial production. They are first tested at Swift

Current for one or more years. Those that show promise in these tests are then tested on the Substations. These Substations are described in another section of this report. It is well known that varieties differ in their response under different soil and climatic conditions. By testing them on the Substations, which represent different conditions, a much better idea of the adaptability and usefulness of a variety can be obtained than when the variety is tested at only one location.

During the past 10 years, many varieties have been tested. In the following paragraphs the results obtained are summarized for those varieties that have been widely grown and those that appear promising at the present time. *It should be pointed out that the results presented apply to southwestern Saskatchewan only and different results may be expected in other areas.*

As the process of testing varieties is a continuous one, and as new varieties are constantly becoming available, the varieties that are recommended frequently change. In order that the Saskatchewan farmer may have the latest information at his disposal, a booklet is published in January of each year. This is entitled "Recommended Varieties of Grain Crops for Saskatchewan". It is prepared by the Saskatchewan Cereal Variety Committee. Copies may be obtained from any of the agricultural institutions in the province, and should be consulted for up-to-date information on variety recommendations. The descriptions of varieties given in this report have been drawn from other sources as well as from the Swift Current Experimental Station.

Common Wheat

Thatcher has been the highest yielding variety in the tests conducted by this Station. It has short, strong straw, early maturity, and high resistance to shattering. The kernels are small and tend to bleach when exposed to weathering. When exposed to hot winds and drought, the bushel weight is frequently low. Thatcher is resistant to stem rust and loose smut, moderately resistant to common root-rot, and susceptible to leaf rust and bunt. It is susceptible to sawfly damage. Thatcher is recommended for all parts of southwestern Saskatchewan.

Rescue is the new sawfly-resistant variety produced at this Station. Compared with Thatcher, it is almost equally high yielding under sawfly-free conditions, or where all cut stems are recovered by hand. Under field conditions, when sawfly infestations are heavy, it gives much better returns than Thatcher. Rescue has weaker straw than Thatcher, of equal length, slightly later maturity, and almost equal resistance to shattering. The kernels are larger, brighter, have less tendency to bleach and are higher in bushel weight. It is resistant to stem rust, moderately susceptible to root-rot and susceptible to leaf rust, bunt and loose smut. Rescue is recommended for all areas of southwestern Saskatchewan where sawfly damage may be expected.

Apex, compared with Thatcher, is lower yielding, has somewhat longer but weaker straw, slightly later maturity, and equal resistance to shattering. The kernels are slightly larger, brighter, have less tendency to bleach, and are somewhat higher in bushel weight. It is resistant to stem rust, moderately resistant to root-rot, bunt and loose smut, and moderately susceptible to leaf rust. Apex is no longer recommended in this area, primarily because it is lower yielding than Thatcher.

Reliance is an awned variety. Compared with Thatcher, it is equally high yielding, has somewhat longer, weaker straw, considerably later maturity, and less resistance to shattering. The kernels are larger, brighter and have less tendency to bleach. It is moderately resistant to root-rot but susceptible to stem rust, leaf rust, bunt, and loose smut. This variety has the ability to retain its bushel weight and grade when grown under extremely dry conditions to

a much greater degree than Thatcher. Because of this characteristic and high yielding ability, it is useful for production in extremely dry areas, particularly along the Alberta border.

Canus is similar to Reliance except that it has stronger straw, much more resistance to bunt, and a greater tendency to shatter.

Regent, compared with Thatcher, is lower yielding, has slightly weaker straw of equal length, earlier maturity, and equal resistance to shattering. The kernels are larger and have less tendency to bleach. Like Thatcher, it tends to be low in bushel weight under extremely dry conditions. It is resistant to stem rust, some forms of leaf rust, and to bunt, moderately susceptible to root-rot and susceptible to loose smut. Regent is not recommended.

Marquis, compared with Thatcher, is lower yielding, has longer, equally strong straw, and considerably later maturity, and equal resistance to shattering.

Redman, compared with Thatcher, is lower yielding, has straw of equal length and strength, slightly earlier maturity, and equal resistance to shattering. The kernels are larger and have less tendency to bleach, but like Thatcher, shrink badly under drought conditions resulting in low bushel weights. Redman is resistant to stem rust, to some races of leaf rust, and to bunt. It is moderately resistant to loose smut and, moderately susceptible to root-rot and susceptible to sawfly damage. Because of its low bushel weight and lower yield than Thatcher, it is not recommended.

Durum Wheat

Under drought conditions, durum varieties usually yield less than such bread wheats as Rescue and Thatcher. As conditions become more favourable, the relative yields of the durums improve. They are much later maturing than the bread wheats. In general they are more susceptible to common root-rot and in years of grasshopper outbreaks frequently suffer more damage because of their late maturity. On the other hand, they compete well with Russian thistle because of their longer straw, and usually exhibit fairly high resistance to sawfly attack. Mixtures of durum and bread wheats are very undesirable and are severely degraded. When durums are being grown, every precaution is necessary to prevent mixing.

Stewart is the most satisfactory variety. It has good quality and is eligible for the top grades. Compared with Stewart, Pelissier has yielded higher, but this variety has inferior quality and is not eligible for grades hghter than 3 C.W. Mindum and Carleton are equal to Stewart in quality, but Mindum is slightly lower and Carleton much lower in yield.

Winter Wheat

In general, winter wheat has not been a successful crop at Swift Current since, in the the majority of years, it has been badly thinned or completely killed by winter injury. However, in certain parts of southwestern Saskatchewan, it has been reasonably successful and is likely to become even more so as cultural methods for growing this crop are improved. When it survives the winter it usually yields more than spring wheat and, when July droughts are severe, the difference in favour of the winter wheat is frequently very great. Instances are on record of winter wheat yielding 10 to 12 bushels per acre under such conditions when adjoining spring wheat was a complete failure.

Many varieties of winter wheat have been tested. Yogo and Kharkov have been the only varieties with sufficient winter hardiness to warrant consideration. Comparing these two, Yogo has been the most satisfactory. It has been equal or slightly superior in winter hardiness, slightly higher in yield, and much more resistant to shattering and bunt.

Barley

Prospect was developed at this Station from a natural hybrid in Black Barbless. It is a high yielding, early maturing, smooth-awned, six-rowed type. The straw is moderately long and moderately strong. It is reasonably satisfactory for combining, but it has a tendency to shatter rather badly in years when a heavy crop is produced. The seed is yellow, of medium size, high in bushel weight, and is eligible for Grade 2 C.W. yellow. It is susceptible to rusts and smuts. Prospect has proved to be especially adapted to the drought area of Saskatchewan, where it has given good yields even in unfavourable years. It is being replaced by Titan.

Titan is a smooth-awned, six-rowed variety which appears to be well adapted to conditions in southwestern Saskatchewan. Compared with Prospect it is higher yielding, equally early, has shorter, stronger straw, is more resistant to shattering and neck breaking, and has smaller seeds with a higher bushel weight. It is eligible for the feed grades only. It is resistant to loose and covered smut, but is susceptible to stem rust. Titan is a new recommended variety of considerable promise, and is one of the best combine varieties. It is rapidly replacing Prospect as seed becomes available.

Plush is a smooth-awned, six-rowed variety which is lower in yield than Titan, and considerably later in maturity. It has longer, slightly weaker straw, is slightly more susceptible to shattering and neck breaking, and has smaller seeds with a lower bushel weight. It is eligible for the feed grades only, and is susceptible to the smuts and rusts. Plush is not recommended.

Vantage is a new, six-rowed, smooth-awned variety very similar to Plush. Compared with Titan, it is lower yielding, later maturing, has slightly longer, equally strong straw, and is equally resistant to shattering and neck breaking. It has smaller seeds that are lower in bushel weight. Vantage is eligible for the feed grades only, and is susceptible to the smuts and rusts. It is not recommended.

Rex is a smooth-awned, two-rowed variety which is lower yielding than Titan, later maturing, has shorter, equally strong straw, is slightly more susceptible to shattering and neck breaking, and has larger seeds that are equal in bushel weight. It is eligible for the feed grades only. In disease reaction, it is susceptible to smuts and rusts. It is recommended where a two-rowed variety is desired, and is a good variety for combine harvesting, since it is fairly resistant to shattering and breaking.

Newal is a smooth-awned, six-rowed variety which, compared with Titan, is slightly lower yielding, slightly later in maturing, has longer, equally strong straw, is more susceptible to shattering and much more susceptible to neck breaking. The seed is slightly smaller, slightly lower in bushel weight and eligible for Grade 2 C.W. yellow. It is susceptible to rusts and smuts. Newal is not recommended primarily because of the tendency for the heads to break off at maturity.

Hannchen is a two-rowed, rough-awned variety which, because of its relatively low yield, short, weak straw, late maturity, and susceptibility to smuts and rusts, is no longer recommended.

Trebi is a six-rowed, rough-awned variety which, compared with Titan, is slightly lower in yield, slightly later in maturity, and is equally resistant to shattering and neck breaking. The seed is larger, courser, much lower in bushel weight and eligible for the feed grades only. Trebi is resistant to loose smut, but susceptible to covered smut, and stem rust. It is no longer recommended because of the rough, coarse awns that are troublesome in feeding.

Warrior is a six-rowed, hooded variety which, compared with Titan is lower yielding, earlier maturing, and has straw of equal length and strength. It is susceptible to shattering, but is fairly resistant to neck breaking. The seed is

low in bushel weight. It is resistant to loose smut, but susceptible to covered smut and stem rust. Warrior is the best of the available hooded varieties.

Colsess is another rix-rowed, hooded variety. It is inferior to Warrior, being lower yielding and later maturing.

Compana is a new two-rowed, smooth-awned variety that is now being widely grown in the drier parts of Montana. It is not equal in yield to Titan except under extremely dry conditions, and the straw is shorter and weaker. It is equally early and equally resistant to shattering and neck breaking. The seed is larger than that of Titan, but lower in bushel weight in dry years. It is eligible for the feed grades only. Compana is moderately resistant to loose smut, moderately resistant to covered smut, and susceptible to stem rust.

Glacier is another new, six-rowed, semi-smooth-awned American variety with very dense spikes. Compared with Titan it is lower in yield, equally early in maturity, has equally long, slightly weaker straw, and is more resistant to shattering and neck breaking. It is resistant to covered smut, but highly susceptible to loose smut and stem rust. The seed is large, coarse and low in bushel weight. Glacier is not licensed for sale as seed in Canada.

O.A.C. 21 is a six-rowed, rough-awned variety. It is the standard malting variety for Canada. Compared with Titan it is much lower yielding, later maturing, and more susceptible to drought injury. It shatters and breaks very badly, hence it is unsuitable for combine harvesting. O.A.C. 21 is not recommended.

Montcalm is a new, six-rowed, rough-awned variety equal to O.A.C. 21 in malting quality. In preliminary tests this variety has been higher yielding than O.A.C. 21, but is still much lower yielding than Titan. Like O.A.C. 21, it shatters and breaks badly. Montcalm is not recommended.

Oats

Ajax is high yielding, early maturing, has good length and strength of straw, resistance to the prevalent form of stem rust and moderate resistance to smuts. The seed is small, low in hull percentage, and low in bushel weight. Ajax is recommended because of its high yielding ability and early maturity.

Exeter, compared with Ajax, is slightly lower yielding, later maturing and has equally long but weaker straw. The seeds are larger, have more hull and are higher in bushel weight. It is resistant to the common forms of stem rust.

Fortune is a new variety highly resistant to the oat smuts. Compared with Ajax, it has been lower yielding, somewhat later maturing, and has produced grain of approximately equal quality.

Banner, compared with Ajax, is lower yielding, considerably later maturing, and has slightly longer straw. The seeds are larger, have more hull and equal bushel weight. It is rust susceptible.

Victory is similar to Banner except that the seed has a more attractive appearance and is higher in bushel weight.

Valor, compared with Ajax, is considerably lower yielding, much earlier maturing, and has larger seeds that are higher in bushel weight. It is resistant to smuts, but susceptible to rusts.

Brighton is a hulless variety. Compared with Ajax, it will not produce as many pounds of feed per acre even when the hulls of Ajax are subtracted. It is later maturing, more prone to shatter and gives off a dust that is very irritating to some people. Brighton is the best of the hulless varieties that have been tested, and may be used where hulless oats are required as a special purpose feed.

Flax

Royal is a high yielding, late maturing variety with medium-sized, brown seed with a characteristic shading off toward very pale brown at the big end. This variety has the objectionable feature of peristing to bloom after most of

the balls are ripe, thus making it difficult to straight combine. Royal is resistant to wilt and the prevalent forms of rust. It is the recommended flax variety.

Dakota is highly resistant to both wilt and rust. Compared with Royal, it matures earlier and more uniformly but has given somewhat lower yields. It is not recommended as yet.

Viking is a variety having fairly large yellow seeds. Compared with Royal, it is very slightly lower yielding, slightly earlier, and has distinctly shorter straw. Under dry conditions, Viking is so short that it is often difficult to harvest. Viking is resistant to wilt and rust. It is not recommended.

Bison, compared with Royal, is lower yielding and slightly earlier maturing. Bison is resistant to wilt but susceptible to rust. Because of its rust susceptibility, Bison is no longer recommended.

Redwing, compared with Royal, is much lower yielding and much earlier maturing. It is resistant to wilt but moderately susceptible to rust. Redwing is not recommended because of its low yield.

Rocket is a new variety resistant to both wilt and rust. In tests conducted to date, it has not yielded as much as Royal. It is not recommended since it has not been sufficiently tested as yet.

Rye

Rye is a particularly useful crop in this area because of its ability to produce a crop under adverse conditions. Fall rye is particularly valuable for the control of wind and water erosion on light soils. This crop is frequently used as an annual hay crop with good success. When so used it should not be cut until it has reached the dough stage, as the best quality feed is secured at that time. Dakold has proved to be the most satisfactory variety of fall rye, because of its high yield and winter hardiness. Most of the rye grown locally is of this variety. Any rye that has been grown successfully in a district for several years is likely to make good seed as the inferior plants will have been killed out. Prolific has been the best of the spring ryes, and is the only one in which seed supplies are available locally.

Fig. 1.—Examining wheat stem sawflies from wheat hybrids. In studying resistance to this pest, the damage to the crop is noted and then the sawflies from each line are examined and their general vigour, size, and fecundity noted.

FIG. 2.—Testing for sawfly resistance. Note the resistant lines on the left as compared with the susceptible ones on the right. (Photograph by Kloppenborg).

FIG. 3.—Inoculating barley hybrids with loose smut. Using a hypodermic needle, the spores of this disease are injected into each floret of the barley plants being studied. Seeds from susceptible lines produce infected plants; those from resistant lines, healthy plants.

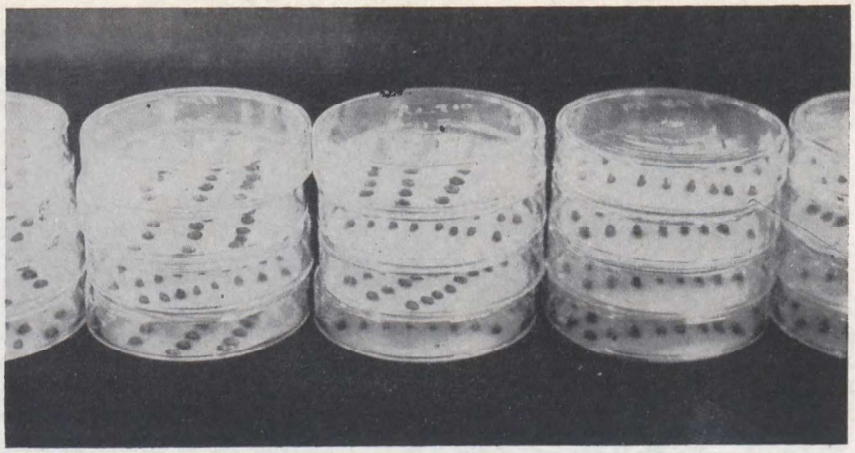

FIG. 4.—Seed of wheat hybrids inoculated with common root-rot. Susceptible lines will fail to germinate or produce badly diseased seedlings, whereas resistant lines will produce healthy plants.

FIG. 5.—Wind damage to barley. Heavy winds frequently break the stems, snap off the heads or cause shattering. One objective of the barley breeding program is the production of lines highly resistant to this type of damage.

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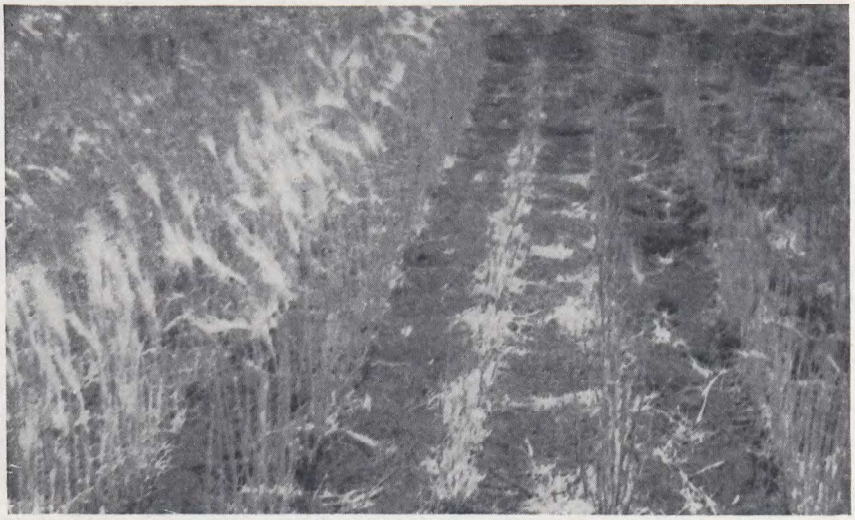


FIG. 6.—Barley varieties showing differences in grasshopper damage. Plot No. 99 is Prospect showing very little injury, whereas Canadian Thorpe, Plot No. 100, has been eaten practically to ground level.

FIG. 7.—Seed increase plots of new hybrids on irrigated land. By means of irrigation, seed of promising new lines can be produced in maximum quantity for further tests or for distribution to growers.

FORAGE CROPS

The principal function of forage plants is to provide a year-round supply of feed for livestock in the form of hay and pasture. Experimental work with forage crops at this Station has been directed toward that objective in the fields of:

(1) Plant testing, selection and breeding.

(2) Methods of seeding and harvesting for hay, pasture and seed production.

(3) Investigations on native grass lands to determine the best pasture management practices and to obtain the best use of land.

The acreage seeded to perennial forage crops, and particularly crested wheat grass, has increased greatly during the past decade. Seedings on abandoned and poor quality land on farms, ranches and community pastures have provided supplies of feed for an increasing livestock population as well as obtaining better land use. The principal crops on irrigation projects in southern Saskatchewan are alfalfa and grass-legume mixtures; these crops assure reserves of forage for livestock in adjacent districts, as well as fitting in crop rotations that conserve and improve the soil.

In addition to providing feed for livestock, forage crop production assists to stabilize the farm economy. The seeding of hardy perennial grasses to wind and water eroded lands brings these areas back into a productive use. Perennial grasses and legumes add fibre to the soil and improve the physical and chemical properties of the lands on which they are grown. The production of seed is a profitable cash crop. Thus forage crop production is basic to a better balanced and a more stable and prosperous agriculture.

Forage Crops on Dryland

The success of forage crop production on dryland is influenced greatly by the choice of crop and the cultural practices followed. The results of experiments with many crops, as well as experiments with methods of seeding and harvesting, are presented:

GRASSES

Crested wheat grass has been found to be the most suitable cultivated grass for both hay and pasturage within the brown soil zone and the drier parts of the dark brown soil zone. Because it makes an early spring growth and, when moisture conditions are favourable, an excellent fall growth, it is a desirable grass for spring and fall pasturage. It needs to be grazed heavily in order to provide succulent and palatable forage. Because it is drought tolerant and capable of competing with weeds, it is valuable for reseeding abandoned farm lands and depleted range pastures. The Fairway strain is recommended because it is leafier than other types as well as being equally productive and hardy.

Brome grass is recommended for forage crop production in southwestern Saskatchewan in areas where moisture conditions are above average. It is the best grass for the Cypress Hills area and on low lying fields. Brome grass is slightly less drought tolerant, and begins growth later in the spring than crested wheat grass. Unfortunately, it becomes sod-bound within 3 or 4 years and the yield drops when that condition develops. Parkland and Common Awnless are the two best varieties. Parkland, being less creeping-rooted, does not become sod-bound as quickly as Common.

Slender wheat grass is fairly alkali resistant but has a relatively short life. Consequently, it is useful for seeding down saline flats and in short rotations. It is an excellent crop to seed on low lying areas that are spring flooded for a

period of up to three weeks. It is not recommended for dry upland. Grazier, Fyra and Mecca are recommended varieties, each yielding approximately the same and each possessing equal hardiness.

Other grasses are being tested to determine their suitability. As yet none has been found to be better than crested wheat grass and brome, which must be regarded as the standard grasses for this area. At present, several promising grasses are in test plots, and in the near future may prove equal to or better than those now recommended.

LEGUMES

Alfalfa is the only perennial legume recommended. Its hardiness, drought tolerance and high yielding ability have made it a valuable dryland hay crop. In comparative tests, the variety Ladak has consistently outyielded all other varieties and strains. In addition, Ladak has the greatest resistance to bacteria wilt disease. Ladak is the only recommended variety for this area at present. Of the newer varieties and strains tested, Rhizoma has shown the most promise to date.

Sweet clover is the only biennial legume of economic importance in southwestern Saskatchewan. Its main use is in short rotations where the feed is utilizied as hay. It is not recommended for pasture purposes. Seed should be scarified before seeding, otherwise many seeds lie dormant during the crop year and germinate in subsequent years. Cutting the first year should not be practised unless there is sufficient growth to warrant it. Little damage results from winter-killing if cutting is delayed until late in September. The recommended varieties are Common Yellow, Erector, Arctic and Redfield Yellow.

Grass-Legume Mixtures

Experiments conducted over a 5-year period show that grass-legume mixtures produce higher hay yields than any grass seeded alone or mixture of grasses. This is particularly so when the legume used is alfalfa. The yields obtained from a few of the mixtures tested are presented in Table 19.

TABLE 19.—COMPARATIVE AVERAGE HAY YIELDS OF GRASSES AND GRASS-LEGUME MIXTURES OVER A 5-YEAR PERIOD—1942-1947

Grass or Mixture	Average Yield of Hay in Tons per Acre
Crested wheat grass	0·61
Crested wheat grass and alfalfa	1·27
Brome	0·67
Brome and alfalfa	1·20
Crested wheat grass and brome	0·84

Sweet clover-grass mixtures outyielded the alfalfa-grass mixtures the first year. However, in subsequent years their positions were reversed. Alfalfa maintains itself in the stand much longer when the mixture is not grazed. Besides producing more fodder, grass-legume mixtures have higher feeding value and are more palatable to livestock than grasses grown alone. The recommended mixtures and rates of seeding are presented in Table 22.

Grazing of grass-alfalfa pastures will result in decreasing yields because the stand of alfalfa is gradually reduced. Whenever pastures containing alfalfa are grazed, the livestock should be watched closely, because alfalfa is liable to cause bloating.

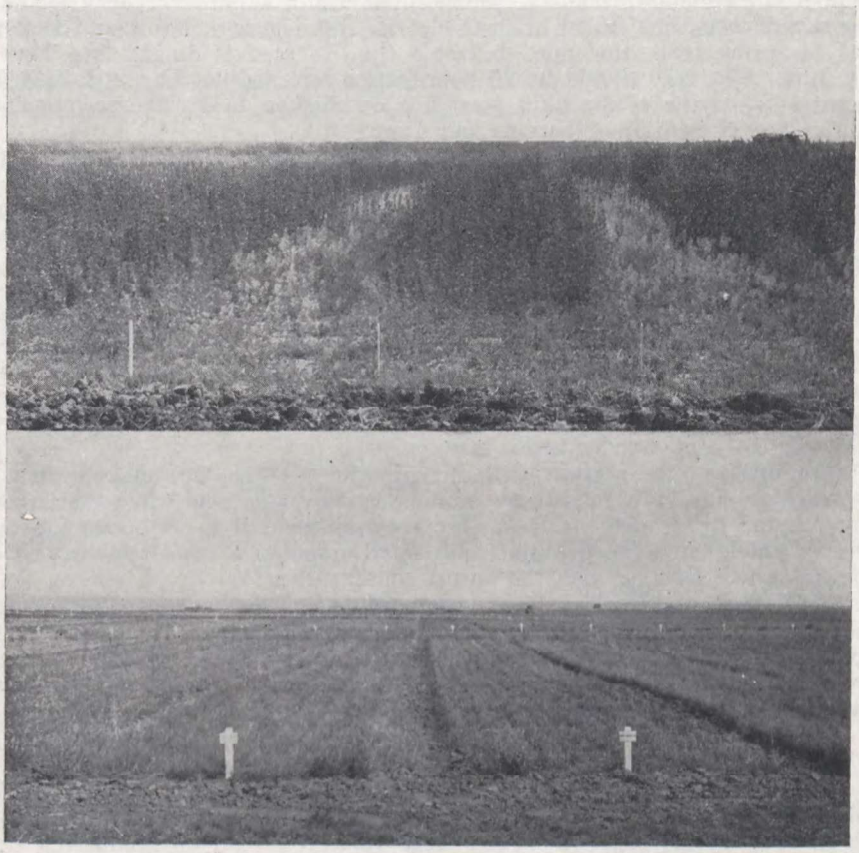


FIG. 8.—(Upper) Effect of fall cutting on survival of first year's growth of sweet clover. Note the severe killing and growth of stinkweed following cutting on August 1 and August 15. No winter killing in plots left uncut on either side of these strips. Photo taken June, 1941.

FIG. 9.—(Lower) Grass-Legume Mixture Test (Dryland) seeded in 1939. Crested wheat grass on left and brome on right. Photo taken spring 1941.

ANNUAL FORAGE CROPS

Cereals as a group outyield all other annuals for hay production. The relative importance of the crops for hay or pasture are oats, barley, wheat, spring rye, and fall rye. To obtain maximum yields, early spring seeding on fallow at the rate of 1 to 1½ times that for grain production is recommended. For hay production the crops should be cut in the dough stage. Pasturing should not begin until the crops have reached a height of 5 to 6 inches. Rotational grazing should be practised. The recommended varieties are Ajax oats, Titan barley, Rescue wheat, Prolific spring rye, and Dakold fall rye.

Mixtures of cereals or cereals with peas do not produce higher yields than the crops grown separately. In addition, they are more difficult to harvest because of variation in height and maturity. The advantage lies in the variety of feed produced.

Millet is a poor weed competitor and requires exceptionally clean land. Although lower yielding than the cereals, it is useful as an emergency feed crop where a first crop has failed. Because of its rapid growth habit and susceptibility to spring frost, the most desirable time to seed is during late May or early June. The rate should be 20 pounds per acre. Millet hay is satisfactory for cattle, while the seed makes good hog or chicken feed. The recommended varieties are Hungarian, Siberian, and Crown.

Corn is less productive than the cereals, but is a valuable crop for ensilage and late fall pasture. For fodder and ensilage purposes, Rainbow flint gives the highest yield but is closely followed by Falconer, Gehu, and Northwest Dent (Morden strain). Of the hybrids tested, Canada 240 and Canada 335 are the most promising.

For grain production, Saskatchewan White flint has produced an average yield of 36·4 bushels per acre on summerfallow over a 6-year period. Gehu produced 28·7 bushels per acre during the same period. Both of these varieties are early, usually maturing seed before fall frosts occur. Seeding in rows spaced three feet apart is recommended, at the rate of about 30 pounds per acre in solid rows and 12 pounds per acre in check rows. Cultivation between the rows is essential to keep weed growth down.

Sorghums have been grown with varying success. They are not recommended for forage production because they produce hydrocyanic acid when their growth is interrupted by drought or frost. Hydrocyanic acid is a poisonous substance affecting cattle and sheep; relatively small quantities cause death. Of the varieties tested, Rancher had the lowest content of acid.

Field peas produce hay yields comparable to cereals, but they are poor weed competitors and the crop is somewhat hard to handle. The fodder is high in protein content and thus valuable in rations for growing livestock. Mixtures of peas and oats make valuable pasture. Chancellor is the recommended variety; best stands result when the rate of seeding is from 2 to 2½ bushels per acre.

Soybeans are not recommended for forage production in this region. They are damaged easily by frost and are susceptible to insect attacks.

Sunflowers are not recommended for forage production in this area. They deplete the soil of all available moisture, necessitating summerfallowing the land where they were grown before succeeding crops can be produced.

CULTURAL PRACTICES

The seeds of perennial forage crops are considerably smaller than those of cereals. Consequently, different methods of seed-bed preparation and seeding practices have to be employed.

Preparation of the seed-bed.—A firm seed-bed, free from weeds, is required for forage crop seeding. A trash cover is desirable, and particularly so on land that is likely to drift. A clean stubble field meets these requirements and seedings can be made in such fields without prior cultivation. Summerfallow and recently cultivated land should be harrowed and packed before seeding.

Crested wheat grass is a strong weed competitor and can be seeded on weed-covered fields. Old growth of Russian thistle and tumbling mustard provide a good cover amongst which to seed crested wheat grass.

Brome, slender wheat grass, alfalfa, and sweet clover are not so good weed competitors as crested wheat grass, and consequently should be seeded either on clean stubble or on a prepared seed-bed.

Date of seeding.—Date of seeding varies for the different crops and depends to some extent on moisture conditions. The safest time to seed grasses is just before freeze-up, whereas with legumes early spring seeding has given the best stands. Crested wheat grass has produced good stands when seedings were made during the period from August 20 to September 10, providing a sufficient supply of moisture was available to germinate the seed and to start growth. Table 20 gives the order of preference for dates of seeding for the principal forage crops.

TABLE 20.—ORDER OF PREFERENCE FOR DATES OF SEEDING

Dates of Seeding	Crested Wheat Grass	Brome	Slender Wheat Grass	Alfalfa	Sweet Clover
Aug. 20 to Sept. 15	2	3	3	4	-
Oct. 15 to Nov. 15	1	1	1	2	2
Apr. 1 to Apr. 30	3	2	2	1	1
May 1 to May 31	4	4	4	3	3

Depth of seeding.—In the past, more failures to obtain stands of forage crops have resulted because of too deep seeding than for any other single reason. The results of experiments designed to test emergence from various depths of seeding are summarized in Table 21.

TABLE 21.—EFFECTS OF DEPTHS OF SEEDING ON EMERGENCES OF CRESTED WHEAT GRASS ON THREE SOIL TYPES

Depth of Seeding	Per Cent Emergence on:		
	Sand	Fine Sandy Loam	Clay Loam
½ inch	75	71	76
1 inch	75	66	64
1½ inch	64	59	44
2 inch	37	29	21

These results indicate clearly that crested wheat grass should not be seeded deeper than one inch, and that greater care should be taken to ensure shallow seeding on heavy than on light textured soils. Brome may be seeded up to 1½ inches in depth and slender wheat up to 2 inches. Alfalfa and sweet clover should not be seeded deeper than one inch. Seeding on the surface or broadcasting is not recommended, because in this climate the surface soil dries out very quickly and seedlings fail to become rooted. It is recommended that pressure springs be removed or released so that drills can ride near the surface.

Nurse crops.—Forage crops should not be seeded with nurse crops in this region. In tests conducted for 15 years, poor stands have resulted when a nurse crop was used.

Spacings and rates of seeding.—During the last 7 years tests have been conducted comparing the yields of crops when seeded in 6, 12, 18, 24, 30 and 36 inch row spacings. The results show there was little difference in yield between the various spacings, but that the plants grow much taller in wider spacings. It was found that, if the forage is to be utilized for hay, the 12 and 18 inch

spacings are best except in the case of sweet clover which is too coarse when grown in rows over 6 inches in width. For pasture, grasses should be sown in 6-inch rows. In Table 22 rates of seeding at diffeernt spacings are presented.

TABLE 22.—RATES OF SEEDING IN POUNDS PER ACRE

Soil Texture	Crop or Mixture	Hay	Pasture	Seed
		Seeded in 12-inch Rows	Seeded in 6-inch Rows	Seeded in 36 to 42-inch Rows
		lb.	lb.	lb.
Loams and Clays	Crested wheat grass	5–6	10	–
	Alfalfa	2	1	–
	Brome	6	12	–
	Alfalfa	2	1	–
	Crested wheat grass	4	6	–
	Brome	2	4	–
	Alfalfa	2	1	–
	Alfalfa	5–6	–	2–3
	Crested wheat grass	–	10	2–3
	Brome	–	14	–
Light Loams and Sand	Crested wheat grass	5–6	10	2–3
	Crested wheat grass	5–6	10	–
	Alfalfa	2	1	–
	Sweet clover	15 lb. in 6-inch rows	–	–

Date of cutting.—The time of cutting and manner of handling are important factors affecting the quality of hay. To obtain the highest yield and feeding value, the following dates of cutting are recommended: crested wheat grass as soon as fully headed; brome at or before flowering stage; slender wheat grass when first starting to flower; alfalfa when in 10 per cent flower; sweet clover when first starting to bloom. Thorough and rapid drying is necessary if good quality hay is to be obtained.

Seed production.—For seed production the grasses should be seeded in rows at the rates and spacings recommended in Table 22. It is necessary to cultivate between the rows to control weeds and small seedlings which result from scattering. Harvesting may be done with a binder and threshed, or either swathed and combined or straight combined.

Forage Crops on Irrigated Land

Forages are the most important crops grown on irrigated land. Usually they occupy most of the land in an irrigated district, as well as on individual farms. Besides their importance for the production of livestock feeds, they are necessary for the maintenance of soil fertility, for controlling weeds and for use in crop rotations.

PERENNIAL AND BIENNIAL FORAGE CROPS

Alfalfa is the most important crop grown on irrigated land. It is well adapted to irrigation conditions, and produces a heavy yield of high quality,

nutritious fodder for a number of years. Although three crops may be grown each year, it is inadvisable to harvest more than two because winter-killing often occurs when the third crop is removed. Alfalfa is well suited to most soil types, provided the land is properly levelled, has good drainage and does not contain excessive amounts of salts. It is recommended that it be seeded at the rate of from 10 to 12 pounds per acre, not over one inch in depth and preferably in the early spring. Drill rows should be 6 inches apart.

FIG. 10.—First cutting of alfalfa, Val Marie Irrigation Project, 1942. Seeded in 1941.

Alfalfa produces heavily. Yields of up to 5½ tons per acre have been harvested at this Station from two cuttings when proper methods of harvesting were followed and sufficient water applied. Ladak, the recommended variety, has produced well in all tests. The first cutting of Ladak yields more than that of other varieties; whereas at the second cutting the reverse condition may occur.

Sweet clover is grown to some extent on irrigated land, but produces less than alfalfa. It is a biennial, that is, it dies out the second year after seeding. It is used mostly in short rotations and on lands which are too saline for alfalfa to grow. Among the varieties tested, Grundy County produced the highest yield, slightly over 4 tons per acre. Decreasingly smaller yields were recorded for Redfield Yellow, Arctic, and Common Yellow, respectively.

Clovers are not suitable crops for the district because of a lack of winter hardiness. Alsike, White Dutch, and Altaswede are the hardiest of those tested but even these will winter-kill frequently. They are most suitable in pasture mixtures; they make excellent hay, but do not yield as heavily as alfalfa.

Brome, slender wheat grass, crested wheat grass, timothy, reed canary, meadow fescue, and creeping red fescue are the most outstanding of several hundreds of grasses tested for hay and pasturage. However, it has been proved that no grass, either grown alone or in mixture with other grasses, produces very large yields after the second or third year. When grown in a mixture with a legume, and particularly with alfalfa, the yield is considerably higher and the stand has a longer productive life. Table 23 compares the 5-year average yield (1943-1947) of recommended grass-legume mixtures and grasses grown alone.

TABLE 23.—COMPARATIVE YIELD OF GRASSES AND GRASS-LEGUME MIXTURES GROWN UNDER IRRIGATION—1943-1947

Grass or Mixture	Average Yield of Hay in Tons per Acre
Brome grass	0·94
Brome and alfalfa	4·15
Slender wheat grass	1·61
Slender wheat grass and alfalfa	4·31

Similar results have been obtained with other grasses seeded alone and in grass-legume mixtures as those presented in Table 23. The hay or pasturage produced by a grass-legume mixture is of high feeding value and is more palatable to livestock than a grass alone.

Recommended mixtures suitable for hay or pasturage are presented in Table 24.

TABLE 24.—GRASS-LEGUME MIXTURES FOR HAY AND PASTURE ON IRRIGATED LAND

Mixture No.	Crops and Pounds of Seed per Acre	Use
1	Brome 12, alfalfa 4	Hay or pasture
2	Crested wheat 10, alfalfa 4	Hay or pasture
3	Slender wheat 12, alfalfa 4	Hay
4	Reed canary 5, alfalfa 3	Hay or pasture
5	Brome 4, slender wheat 4, crested wheat 3, alfalfa 4	Hay or pasture
6	Brome 4, Reed canary 2, slender wheat 4, crested wheat 2, alfalfa 3	Hay or pasture
7	Brome 3, Reed canary 2, crested wheat 2, meadow fescue, 3 timothy 2, creeping red fescue 2, alfalfa 2, alsike or Altaswede clover 2	Pasture

ANNUAL FORAGE CROPS FOR IRRIGATION

Annual forage crops are of less importance than perennials on irrigated land because they yield less, produce poorer quality feed, and cost more to produce. However, they can be used to advantage to meet special conditions, as on land that is insufficiently level to warrant seeding perennial crops, or as a pasture crop in a rotation. Amongst the annual crops suitable for irrigation, millets, corn, peas, annual sweet clover, cereals, rape, kale, and mangels are some of the most valuable. Some of the principal crops are listed in Table 25, together with yield data, rates of seeding, and best use of the crop.

Pastures of annual crops on irrigated land can be used to supplement native and cultivated dryland pastures. They can be used also for hogging-off, lambing-off, and cattling-off. Excellent gains for all classes of livestock can be expected, providing the crop or crops produce a balanced ration. Crops suitable for this purpose include Dwarf Essex rape, kale, mangels, peas, fodder and grain varieties of corn, oats, peas, and fall rye. Rape is an excellent summer and fall pasture for hogs. Blocks of several of these crops can be seeded to provide a season long pasture, an example of such a rotation would be, oats, rape, mangels, peas, and Saskatchewan White flint or Gehu corn.

TABLE 25.—ANNUAL FORAGE CROPS FOR IRRIGATED LAND

Crop	Varieties Recommended	Yield per Acre 5-Year Average	Rate of Seeding	Use
Corn	Rainbow flint	2·64 tons	25 lb. per acre in 3-foot rows or 8-10 lb. per acre in check rows	Fodder
	Northwest Dent	2·62 tons		Ensilage
	Saskatchewan White flint	58·0 bu.		Hogging-off
	Gehu	57·8 bu.		Grain and hogging-off
	Falconer	53·0 bu.		
Sorghum	Early amber cane	3·49 tons	10 lb. per acre in 3-foot spaced rows	Fodder
	Early sumac	3·29 tons		Fodder
Millet	Empire	3·12 tons	20-25 lb. per acre in 6" drills	Hay
	Common	3·29 tons		Hay
Cereals	Thatcher wheat	3·54 tons	2½ bu. per acre	Hay
	Banner oats	3·21 tons	3 bu. per acre	Hay
Mangels	Mammoth long red	15 tons	10-15 lb. per acre in 24" spaced rows	Fodder and pasture
	Royal giant	12 tons		
Annual sweet clover	Melana	2·39 tons	12-15 lb. per acre in 6" drills	Hay
	Hubam	2·39 tons		Hay
Peas	Chancellor	2·06 tons	1½-2 bu. per acre	Hay and pasture
Rape	Dwarf Essex	–	3 lb. per acre in 6" drills	Pasture
Kale	Narrow stemmed	–		Pasture

CULTURAL PRACTICES

The general principles already mentioned regarding the seeding of forage crops under dryland conditions hold equally well under irrigation, but in addition it is essential that the land be well levelled beforehand. If seedings are being made on new land, it is best to grow a cereal crop before seeding down perennial crops to be sure that the land is prepared satisfactorily for irrigation. It is better also to know before seeding the method of irrigation to be used. If a border dyke method is most suitable, the dykes should be built before seeding but, if a ditching method is to be employed, either contour or border, the ditches can be constructed following seeding and before irigation is required.

The land to be seeded may be fall ploughed, cultivated in the spring to destroy weed growth and then levelled. This usually produces a firm seed-bed, but if not the land ought to be packed. Seeding can be done immediately the land is prepared so that the seeds will have a chance to grow before weeds sprout, and to take advantage of all available moisture.

Seeding can be done in stubble if it is relatively free from weeds and shattered grain. In general, best results are obtained by spring seedings, but seeding of all species may be done in the late fall (just preceding freeze-up), while alfalfa, brome, crested wheat, and slender wheat may be early fall seeded (August).

Care is required to avoid seeding too deeply and ought to be drilled in rather than broadcasted. In seeding a pasture, a more uniform stand may be obtained by drilling half the seed one way and cross-drilling the remainder. Nurse crops should not be used, because usually the practice results in a poorer stand of the perennial crop with smaller yields in subsequent years. If a nurse crop is used, it should be seeded quite thinly and harvested as early as possible; flax is the only recommended nurse crop. During the year of seeding the stand should not be pastured, neither should it be cut for hay even if a good growth has been made by early fall. It may be clipped high with a mower to control weeds, if necessary.

Irrigated pastures should not be grazed too heavily. It is a good practice to divide the pasture into two or three small fields and rotate the grazing. When one pasture is being grazed, the others may be irrigated or allowed to make considerable regrowth.

IRRIGATION PRACTICES

No set rules can be laid down as to which irrigation practice to follow when irrigating forage crops. This will depend upon the crop, the soil type, and the season. The object should be to see that the crop does not suffer from lack of moisture even for a short time. Thus the irrigation practice will be such as to maintain soil moisture at a level sufficient for good growth. With a crop such as alfalfa, this may involve from 3 to 5 irrigations each summer. By careful observation, the experienced grower can detect from the appearance of the growing crop the approximate time irrigation is needed. This is indicated by a dark green discolouring of the leaves and a temporary wilting on hot days. However, borings made with a soil auger will indicate soil moisture more accurately than the appearance of the crop.

As a general rule perennial forage crops will require an irrigation in early May, and this together with average rainfall will be sufficient for the first crop. Sometimes dry weather in June will make a second watering necessary for maximum yield of the first hay crop. The second irrigation needs to be applied usually as soon as the first hay crop is removed; and a third may be needed before the second cutting is ready. A fall irrigation should be given in September if water is available as this promotes good fall growth which, in the case of alfalfa, lessens the danger of winter-killing. A fall irrigation ensures good spring moisture conditions and eases the rush of early spring work.

If the supply of irrigation water is limited, it can be used to the best advantage by applying it in the early part of the season, when perennial crops use water more efficiently and there is less loss by evaporation.

As crops use less moisture when they are small, annual forages usually do not require irrigation until July, unless the weather previously has been very dry and hot, or when there is little reserve moisture in the soil. During July and August, when the most growth is made, water requirements are great and it may be necessary to irrigate as often as every ten days or two weeks.

Pastures require frequent irrigations for maximum production and also to keep fresh growth coming on. It is a much better practice to give several light floodings than a few heavy applications. It is not uncommon to water pastures every 10 days during dry, hot weather.

If the weather is dry following seeding and the soil moisture content low, uneven germination and patchy stands may result. The grower should not hesitate to irrigate the seeding up under these conditions. Irrigation at this time will ensure a good stand; however, care must be taken not to wash the soil. Small heads of water need to be used and careful attention paid to proper drainage.

SPECIAL FORAGE CROP INVESTIGATIONS

Forage crop investigations have been conducted since 1937 on the Val Marie, Eastend, and Maple Creek Irrigation Projects as well as on a number of smaller, privately-owned schemes. At Eastend and Maple Creek this work was confined principally to testing crops and varieties suitable to those areas, but at Val Marie a special problem existed. The soil there is a very heavy clay or "gumbo" type, relatively impermeable to water and containing considerable quantities of saline salts. Experiments were conducted to determine the best crops for this type of land and how satisfactory stands could be secured and maintained in a productive state.

Because the soil is very heavy it puddles when wet. On drying it forms a hard crust which small seedlings, such as grass and alfalfa, cannot penetrate. In addition the soil is quite cold, and the presence of salts reduces germination of seed. Many experiments were conducted to determine how to secure stands under these conditions. The best results were obtained by broadcasting the seed on the surface. When rain fell or an irrigation was given following seeding, the soil would melt down and cover the seeds lightly and they would germinate quickly before a crust could form.

Once it had been determined how to get good stands established, tests were conducted to find out the best crops for such land. Among the more outstanding were slender wheat grass, brome, crested wheat grass, reed canary grass, meadow fescue, alfalfa, sweet clover, and oats. It was also found that a single grass produced very low yields, and that alfalfa was only suitable where proper drainage could be secured. On the greater part of this land, a grass-legume mixture was found to be the most suitable crop to grow from the standpoints of yield and maintenance of the stand.

It was found also that growing perennial forage crops made the soil more permeable to irrigation water, and thus more water could be stored in the soil at each irrigation. In addition, it was found that the amounts of saline salts were reduced at the surface as they were leached down in the irrigation water.

Many areas similar to Val Marie exist elsewhere in southwestern Saskatchewan, and most of these have irrigation or spring flooding possibilities. Development of such areas, based on the experimental work already conducted, would result in a tremendous increase of feed reserves.

FORAGE CROPS FOR SPRING-FLOODED LAND

Land subject to spring flooding may be used more advantageously for the production of perennial forage crops. In some instances the run-off water may be controlled and held on the land as long as desired, while in other cases, such as sloughs which do not have any drainage, the water will stay until it evaporates or percolates away. Any forage crop seeded in such a location would have to be able to withstand the longest period of flooding which occurred. It is well known that crops differ considerably in this respect, some being able to tolerate longer flooding than others. Considerable information on the effect of early spring flooding was obtained by experiments conducted at the Val Marie and Eastend Irrigation Projects. By actually flooding various crops for different lengths of time in the spring, it was possible to determine how long several commonly grown forage crops may be flooded without causing injury to the stands.

TABLE 26.—SUGGESTED FORAGE CROP MIXTURES FOR SPRING-FLOODED LANDS

Period of Flooding	Mixture in Pounds per Acre
1½ to 2 weeks	Brome 5, crested wheat grass 4, slender wheat grass 4, alfalfa or sweet clover 2
1½ to 3 weeks	As above but no alfalfa or sweet clover
3 to 4 weeks	Slender wheat grass 4, meadow fescue 3, brome 4, timothy 2
4 to 7 weeks	Meadow fescue 4, timothy 2, reed canary grass 3
Longer than 7 weeks	Reed canary grass 4, timothy 2

These results can be used as a guide for the seeding of low lying areas subject to spring flooding, providing information is available on the approximate length of time the land is flooded. Recommended mixtures to seed on spring-flooded lands are presented in Table 26.

Forage Plant Improvement

Forage plant improvement studies have shown the urgent need for better strains and varieties of forage crops. The development of drought tolerant varieties is one of the main objectives, but high yields of seed and feed, winter hardiness, disease tolerance, palatability, high nutritive value, and stand longevity are other characteristics which must be secured in the new varieties.

PLANT NURSERIES

Seed samples of numerous species of forage crops have been obtained from various parts of the world and established for observation in dryland and irrigation nurseries.

The performances of these have been compared with those of standard forages such as alfalfa, sweet clover, crested wheat grass, and brome grass. Seed of the more desirable species has been increased and included in the regular variety tests. Some of these also have been included in mixtures used in large scale re-grassing experiments and the stands obtained are quite promising. Some of these newer varieties that may prove useful are as follows:

Agropyron desertorum (Desert wheat grass)—Grows slightly taller than crested wheat grass but is not so leafy.

Agropyron elongatum (Tall wheat grass)—This is a tall growing grass quite palatable, fairly drought resistant, and showing considerable promise for use on alkali soils with high water-tables.

Elymus junceus (Russian wild rye)—A hardy drought tolerant bunch grass. It is fairly palatable and nutritious.

Elymus virginicus var. *submuticus* (Virginia wild rye)—A leafy palatable grass that produces a heavy yield of hay and pasturage the first two years after seeding.

Agropyron intermedium (Intermediate wheat grass)—A hardy grass with creeping rootstalks that appear to be winter hardy. It is tall and very palatable. This species is very variable as to type.

Stipa viridula (Green speargrass)—This native tall growing grass is fairly drought tolerant and of good quality.

Many other grasses, legumes, and other forage plants are being tested, and some of these may prove of value both on irrigated and on dry land.

PLANT BREEDING

Plant breeding projects are being conducted with corn, crested wheat grass, Russian wild rye, Virginia wild rye, intermediate wheat grass, sweet clover, and alfalfa.

CORN

Saskatchewan White Flint (Rhodes strain).—This is a low growing, early maturing corn that has consistently outyielded any other variety of shelled corn. This strain was obtained originally from a variety of mixed flint grown by E. C. Rhodes of Maple Creek. It has been recently improved and the amount of seed increased.

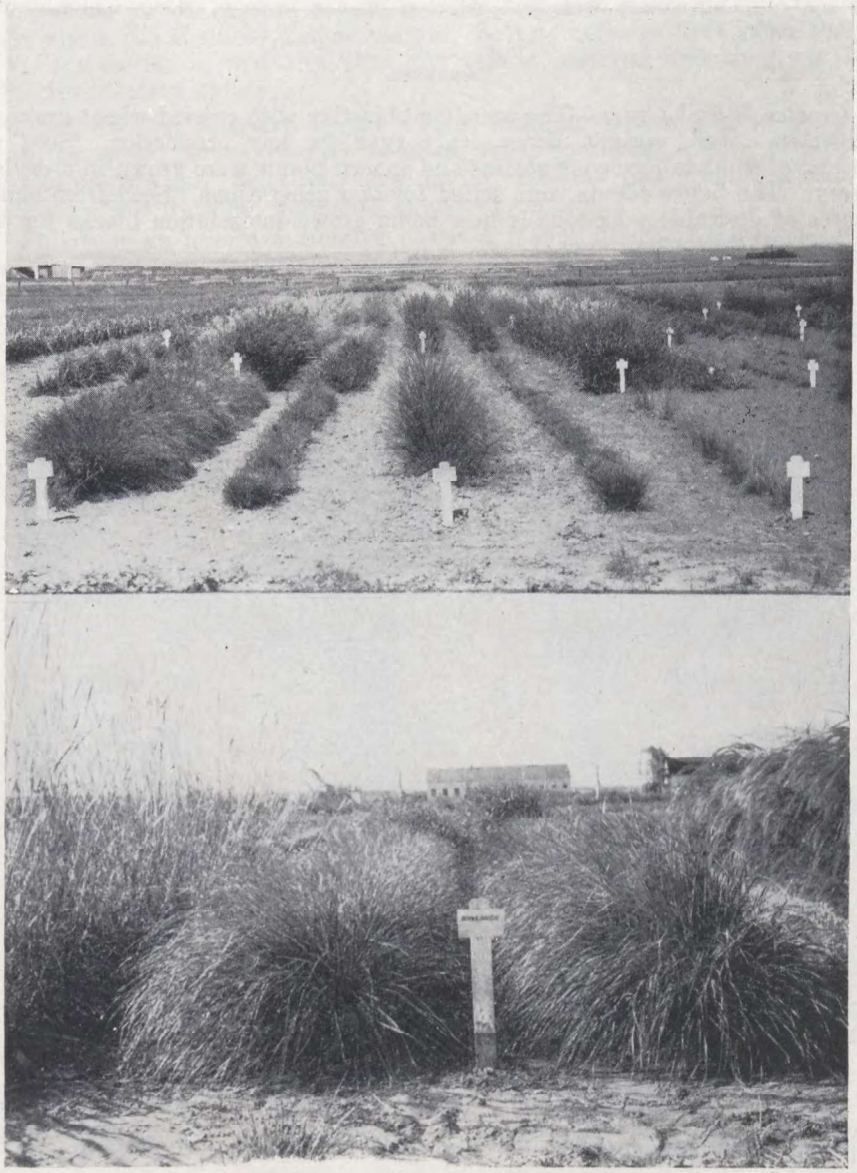


FIG. 11.—(Upper) Forage crop nursery on dryland, 1940.

FIG. 12.—(Lower) *Elymus junceus* (Russian wild rye) in the forage crop nursery. August 1, 1939.

Gehu Yellow Flint (Maple Creek strain).—An early maturing strain that produces high yields of shelled corn. The plants grow to a medium height and are very leafy. This strain was first selected on the farm of P. C. Colquhoun of Maple Creek.

GRASSES

Crested Wheat Grass.—The breeding objective with crested wheat grass was to develop a tall, upright, dense, leafy type for hay production. Seed was obtained of some tall growing strains and spaced plants were grown in a dryland nursery. The better plants were selfed for two generations. Seed from similar cultures of desirable selections is now being grown in isolation blocks for seed increase and testing purposes.

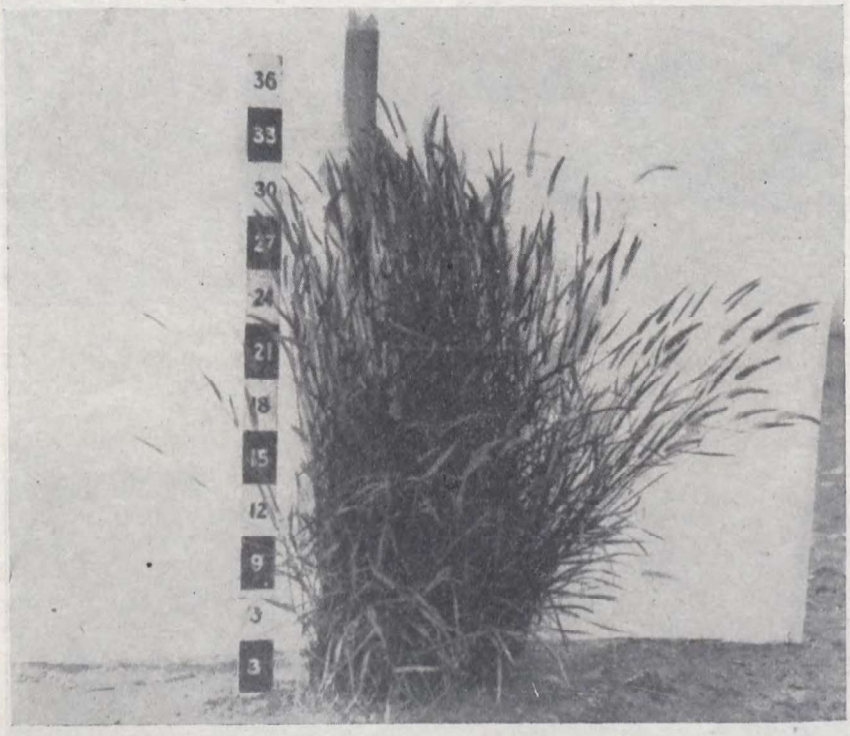


FIG. 13.—A selected tall growing crested wheat grass plant.

Russian Wild Rye.—In some years this species fails to head out and set seed. Selections for greater seed productivity are being made as it appears to be a desirable pasture type.

Virginia Wild Rye.—This species shows promise as a hay crop, particularly under irrigation. The seed germinates rather slowly under cool conditions, and selections are being made on the basis of quick germination. Quick germinating lines have been obtained and are being established for seed increase and in evaluation tests.

Intermediate Wheat Grass.—This species shows considerable variation as to creeping rooted habit and erectness of growth. The breeding program is to select and develop improved strains.

Redfield Yellow Sweet Clover.—Selection of early maturing lines has been made within the Redfield Yellow variety. Several cultures have been obtained which are earlier in maturity than the parent material and they are being tested for yielding ability.

Alfalfa.—The objective in the alfalfa breeding program is to develop a hardy, drought tolerant, disease resistant, creeping rooted alfalfa for dryland hay and pasture use. Selections from Ladak, Siberian (*Medicago falcata*), and the new variety Rhizoma were used as parent material.

Following an intensive crossing program among desirable selections, plants have been obtained which have an extensive creeping root, are high in forage value and hold their seed well. These outstanding plants are being intercrossed and tested to determine their combining ability. In addition, they will be tested for resistance to wilt and crown-rot at the Plant Pathology Laboratories at Lethbridge and Edmonton.

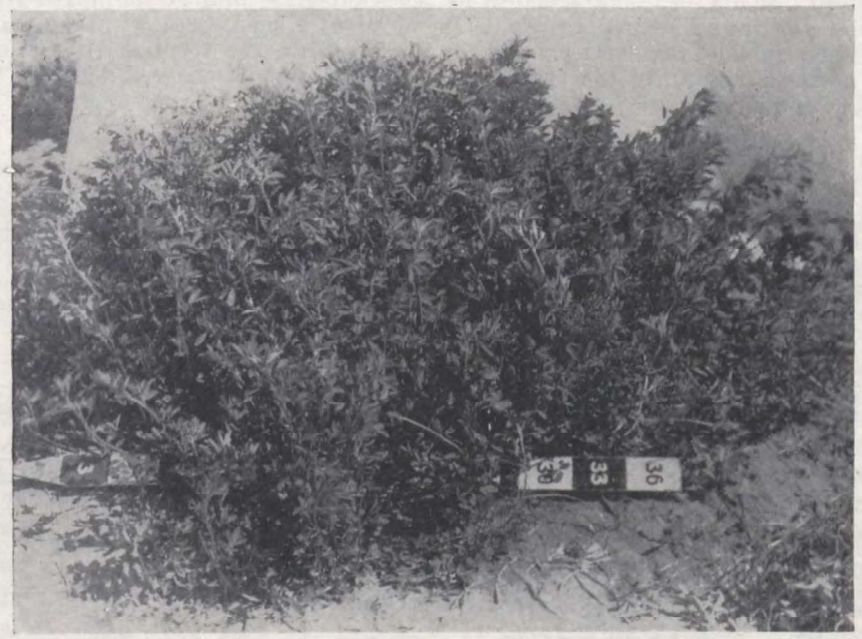


FIG. 14.—An F1 between Ladak and Siberian showing plant spread in two years.

A number of isolation plots have been established from outstanding combinations for seed increase purposes. Seed from these isolation plots is now being tested for seed yield and yield of hay in grass mixtures. Clipping tests will be conducted to determine the resistance to grazing conditions and the competitive ability of the creeping rooted alfalfa in a grass mixture. Material, which shows outstanding performance, will be increased for further testing and distribution.

A strain of Ladak is being developed from selected Ladak plants which had survived an early spring frost. This selection yields as high as the parent material.

The Native Vegetation and Grazing Practices

Nearly 30,000,000 acres of native grassland in the southern portion of Alberta, Saskatchewan, and Manitoba are used for grazing purposes. The forage grown on this acreage provides about 60 per cent of the feed consumed by the horses, cattle, and sheep within the region. These non-arable lands provide a supply of cheaply produced forage which is the base of the livestock industry in the Prairie Provinces. Investigations of this resource are being conducted to determine the best management practices and to obtain the best use of land.

NATIVE VEGETATION OF THE PRAIRIES

The vegetation of the southern portion of the Prairie Provinces has been studied; plant specimens have been collected and identified, and placed in the herbarium at the Station. Collections have been made from the Red River to the Foothills, and to date over 1,600 species have been gathered. This collection represents 120 plant families and 485 genera.

There are three principal grassland associations in the prairie area of Western Canada. These are known as the short-grass prairie, the mixed-grass prairie and the submontane prairie. In addition, a small area in Manitoba is classified as tall-grass prairie. Within the Foothills, the Cypress Hills, along the northern margin of the prairie area, and in small districts throughout the region, stands of forest type vegetation are found.

YIELDS OF GRASSLANDS

Yields of grasslands vary from year to year. This is caused by the climate, the condition of the pasture, the grazing history of any particular range as well as other factors. This variation is indicated in Table 27, where yields from clipped plots are presented; these are for a short period of time but include years of high, average, and low rainfall.

TABLE 27.—YIELD OF FORAGE FROM CLIPPED PLOTS OVER A 6-YEAR PERIOD—1941-1947

Site	Vegetational Type	Yield in Pounds per Acre		
		Low	High	Average
Swift Current	Short-grass prairie	141	309	197
Cadillac	Mixed-grass prairie: Spear-grass type	92	560	208
Matador	Mixed-grass prairie: Blue-joint type	209	868	419
Cypress Hills	Rough fescue type	559	1,362	985
Ituna	Forest	334	975	547
	Wet hay meadow	3,928	7,244	6,068
	Spring-flooded meadow	1,222	3,250	1,920
	Dry meadow	261	798	462
Webb	Crested wheat grass	471	624	548
	Short-grass prairie	228	280 (2)	254
	Sandhill	430	503	467

(2) 1946 and 1947 only.

The results indicate that the greatest percentage range in yield is on the mixed prairie-speargrass type, where a range of over 600 per cent is recorded. Smaller variations are found in the mixed prairie-bluejoint type and for the

shortgrass prairie. Yields from the "Wet hay meadow" are very high and relatively constant from year to year; if these meadows dry up, their yields are reduced to about one-fifteenth of their productive capacity.

All grass species have different yielding powers, some relatively high, others very low. As an example, speargrass will yield three times as much as blue grama grass on equal sized areas, while rough fescue will yield twice as much as speargrass. Comparative yields of different species are presented in Table 28.

TABLE 28.—RELATIVE PRODUCTIVITY OF SEVERAL SPECIES OF GRASS

Plant Species	Relative Productivity	Plant Species	Relative Productivity
Speargrass	1·00	Thread-leaved sedge	0·80
Blue grama grass	0·33	Rough fescue	2·05
Bluejoint	1·30	Parry's oatgrass	1·00
Junegrass	0·97	Crested wheat grass	2·54
Dwarf bluegrass	0·60		

Experimental evidence indicates that speargrass produces about 40 per cent of the forage, and blue grama grass and bluejoint each about 25 per cent of the forage on the short-grass prairie. Within the mixed grass prairie region, speargrass and wheat grasses together provide from 50 to 80 per cent of the forage consumed by livestock. Rough fescue produces about 60 per cent of the forage in the submontane prairie type. In planning a grazing program to utilize these lands, cognizance needs to be taken of the growth habits of the heavier producing species.

CARRYING CAPACITY

Carrying capacity is defined as the number of acres required to provide enough forage to produce from 325 to 350 pounds of gain on a two-year-old steer during the months April to October inclusive. On this basis the carrying capacities of the three principal grassland types have been measured; these are summarized in Table 29.

TABLE 29.—AVERAGE YIELD AND CARRYING CAPACITY OF THE THREE MAJOR VEGETATIONAL TYPES

Major Vegetational Types	Yield in Pounds per Acre			Carrying Capacity in Cows per Section			Average Yield Ratio
	Highest	Average	Lowest	Highest	Average	Lowest	
	lb.	lb.	lb.	No.	No.	No.	
Short-grass prairie	332	265	170	25	20	11	1·00
Mixed prairie	760	427	200	50	33	15	1·65
Submontane mixed prairie	1,500	705	345	108	55	26	2·75

When a pasture is first stocked with cattle, it is advisable to graze it at a rate slightly below the average for each grassland type. Then, according to the results of grazing practices, the herd can be adjusted to the carrying capacity

of that particular parcel. If a shorter grazing season is practised and if a large number of yearlings are being grazed, then the number of livestock pastured can be increased proportionately.

Regulating the grazing to the carrying capacity of a pasture is essential if beef and forage production are to be maintained. Experimental evidence indicates that on properly grazed fields and on those undergrazed, the yield of animal products remains nearly constant each year, whereas on fields becoming overgrazed, the yield of beef declines within five years to about 60 per cent of that of normally-grazed areas; in addition, mature cattle are unthrifty, and calves will be from 50 to 100 pounds lighter. The trend in the vegetational cover is comparable: there is a reduction in the grass cover and forage yield by from 25 to 45 per cent and an increase in pasture weed population up to 350 per cent.

WATER DEVELOPMENT

Insufficient or poorly distributed stock watering sites reduce the carrying capacity of a pasture. Although cattle will graze over two miles from watering sites and make optimum gains, there will be a definite under utilization of the forage at points more than 1¼ miles from water. In Table 30, summaries of studies are presented relating to distance cattle will graze from watering sites.

TABLE 30.—PERCENTAGE OF THE GRASS COVER EATEN BY CATTLE AT DIFFERENT DISTANCES FROM WATERING SITES IN NORMALLY STOCKED PASTURES

Grass Species Tested	Per Cent of Forage Eaten at Increasing Distances from Watering Sites						
	0–¼ Mile	¼–½ Mile	½–¾ Mile	¾–1 Mile	1–1¼ Miles	1¼–1½ Miles	1½–2 Miles
	%	%	%	%	%	%	%
Speargrass	68	55	57	53	47	28	10
Blue grama grass	55	40	25	29	29	17	4
Bluejoint	70	55	45	36	45	23	2

As best utilization averages from 45 to 60 per cent of the total growth, the data presented indicate that cattle will not graze to the full carrying capacity beyond 1¼ miles from a watering site. Furthermore, at points closer than one-quarter of a mile from a watering site, a certain amount of overgrazing can be expected. On the basis of these data, it is recommended that watering sites be not further than from 2 to 2¼ miles apart. It is further recommended that watering sites be more closely located in areas where the topography is classified as from moderately to steeply rolling or hilly, and in pastures that are grazed by sheep.

CHEMICAL COMPOSITION OF RANGE PLANTS

Chemical analyses have been made of the principal native forage species to determine the nutritive value of the vegetation at different stages of growth and during different seasons of the year. A summary of the chemical composition of five important grasses is presented in Table 31.

As indcated by the table, the chemical composition of native vegetation changes during the growth of the plants. The young herbage has a high content of protein and minerals, and a low content of fibre. As growth progresses the protein, fat, and phosphorus contents drop rapidly. On the other hand, the

proportions of fibre and calcium increase or maintain their contents. Further decreases in protein, fat, and phosphorus are found to exist after overwinter exposure. This seasonal change is characteristic of all classes of forage, both native and introduced, and is most marked in the grasses of the short-grass prairie which begin curing early in the season.

TABLE 31.—AVERAGE CHEMICAL COMPOSITION OF FIVE PRINCIPAL GRASSES OF THE SHORT-GRASS PRAIRIE

Growth Stage	Season of Year	Chemical Composition in Percentage						
		Crude Protein	Crude Fibre	Ether Extract (Fat)	Carbo-hydrates	Total Ash	Calcium	Phos-phorus
Leaf.....	April and May	18·33	25·0	2·57	45·7	9·05	0·390	0·252
Emerging from sheath..	June.....	13·10	29·2	2·79	47·8	7·53	0·274	0·206
Flower.....	June.....	9·83	32·1	2·37	49·1	6·47	0·277	0·181
Medium seed..	Late July.....	7·21	33·7	2·64	49·7	6·66	0·291	0·134
Cured.....	August to January.....	4·85	34·5	1·87	51·7	8·37	0·337	0·084
After winter exposure.....	After January.....	4·02	35·4	1·26	50·8	8·73	0·361	0·062

During the spring and summer, the native forage species appear to supply the nutritional requirements of grazing livestock, but during the fall and winter the forage will be deficient in protein and phosphorus, and particularly so for cows in calf and ewes carrying lambs. These deficiencies can be met by supplemental feeding, oilmeal to supply protein and bonemeal or mono-calcium phosphate to supply the phosphorus requirements. Feeding good quality alfalfa hay is recommended to balance diets low in both phosphorus and protein.

Supplemental feeding of native hay, particularly if cut late in the season, will not supply the proteins and minerals required to balance the winter diet.

POISONOUS PLANTS

Plants poisonous to livestock are found throughout the entire prairie region. Fortunately the stands are generally sparse and several of the species are not palatable. It is suggested that plants which are suspected of being poisonous be sent to the Experimental Station, Swift Current, Saskatchewan, for identification. Also, if it is suspected that certain animals in a herd have been poisoned, notify the district officer of the Agricultural Representative Service, the nearest Veterinary Service or the Dominion Experimental Station, Swift Current. A list of the principal poisonous plants of the prairie region is presented in Table 32.

Poisoning occasionally results from feeding oat hay. There is nothing about the feed to determine whether or not the hay contains the poisonous principle. If losses occur that might be caused by this feed, it is recommended that the stock be placed on other roughage, and the samples of the material be forwarded for analysis to the Dominion Experimental Station, Swift Current, Sask.

When losses occur that are caused by plant poisoning, the first step to take is to change the feed or pasture.

TABLE 32.—PRINCIPAL POISONOUS PLANTS OF THE PRAIRIE PROVINCES

Name of Plant	Where it Grows	When it Appears	Animals Affected	Poisonous Period	Symptoms
Death camas *(Zygadenus gramineus)*.	Moist coulees and plains	April to May	Cattle and sheep	April to August	Slobbering, increase of breathing rate and coma.
Loco weed *(Oxytropis spp.)*	Knolls, ridges and plains	Early spring	Horses, sheep and cattle	Any period of the year	Loss of flesh, irregularity of gait.
Milk vetches *(Astragalus pectinatus)*, *Astragalus bisulcatus)*.	Knolls, ridges and plains. Contain selenium.	May to July	Sheep and cattle	Any time of the year	Loss of flesh; depraved appetite and "blind staggers".
Arrow grass *(Triglochin maritima)*.	Wet alkaline soils, has salty taste.	April to October	Sheep and cattle	April to October	Increase in heart and respiratory action; paralysis and convulsions.
Chokecherry leaves *(Prunus virginiana* var. *melanocarpa)*	Sandhills and coulees	May to August	Lambs, sheep and cattle	Young leaves	As above.
Dwarf larkspur *(Delphinium bicolor)*. Tall larkspur *(Delphinium scopulorum)*.	Open hillsides and brush, Cypress. Hills and Foothills.	June to August	Cattle	Entire life of plant	Inability to walk without stumbling; nausea; bloating; convulsions.
Western water hemlock *(Cicuta Douglasii)*.	Sloughs, ditches, springs and waterholes in creeks.	May	Cattle, horses and sheep	May to October	Acute abdominal pains, excitement and convulsions.

Moderate grazing is the most important single factor in maintaining a pasture at its maximum production. No management system can be recommended which will replace moderate grazing for the purposes of conserving the soil and vegetational cover and stabilizing the rancher's income. However, certain methods of handling livestock and pasture can be employed, which, in conjunction with moderate grazing will increase the carrying capacity and maintain the forage cover.

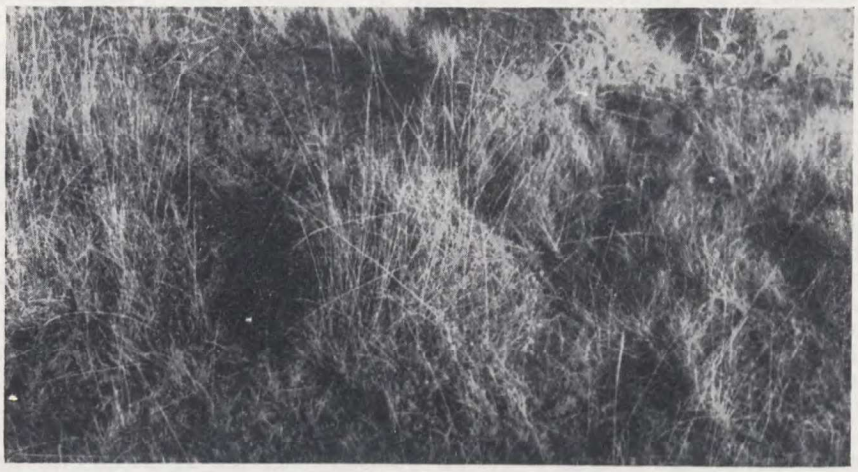


FIG. 15.—Carryover on rough fescue pasture. Leave sufficient to ensure seed production, to prevent erosion, and to maintain the cover in a healthy state.

The principle of moderate grazing is illustrated by carryover. A carryover should be sufficient to:

(1) Provide a reserve of pasture in the event of a dry season ensuing.
(2) Reduce spring run-off and soil erosion to a minimum.
(3) Provide a mixture of old and new grasses for spring grazing the following season.
(4) Maintain the heaviest producing grasses in a productive condition.

This last point is very important, because one of the first effects on the vegetational cover when sufficient carryover is not provided, is the replacement of the most palatable and heavy producing species by pasture weeds. In order to secure these several benefits, a carryover of from 45 to 50 per cent of the season's growth should be left; a portion of this will be utilized the following spring.

Heavy grazing during the first month of growth in the spring depletes the stand of the most palatable grasses. Consequently, deferring grazing on native grass pastures until about one month after growth has started is recommended; very light rates of grazing during the same period are beneficial also. This practice is especially beneficial to heavier-producing species such as speargrass, bluejoint and rough fescue, because it protects them during their most vital growth period. Supplementary pasture is necessary to provide grazing after stock leave the winter pasture or feeding grounds and until the native grass pastures are ready. A field of crested wheat grass, grazed at the rate of one-half acre per cow per month, can be utilized successfully for this purpose.

There is evidence to indicate that reducing the intensity of grazing on summer pastures during the months of September and early October is beneficial to the grass cover. There is a normal increase in grass consumption during the period because calves and yearlings are eating more than they did earlier in the year. Furthermore, plants are building up food reserves in their roots during these months. As crested wheat grass pastures usually make considerable growth during this season, a field planted to this grass could be utilized to reduce the load on the native pastures.

Except for deferring spring grazing and reducing the intensity of fall grazing, it seems advisable to graze summer pastures continuously. No apparent advantages to the livestock are observable by practising pasture rotations. The vegetational cover can be maintained under continuous grazing, providing the rates of stocking are moderate. In planning for use of pasturage, it seems advisable to design the grazing program on the basis of ease of management and the benefits to the grass cover instead of a planned rotation.

The value of winter pasture cannot be over-emphasized. Fields which produce a cover of browse plants and shrubs, as well as tall-growing grasses, are most suitable but any type of vegetation can be utilized. This pasture should be close to the ranch or farm headquarters and needs to be provided with shelter, water, mineral supplements, and feed reserves; it should be protected from grazing from the time growth starts in the spring until the cattle are placed in it in the fall. Experimental evidence indicates that, if weather permits, cattle can secure from 50 to 100 per cent of their winter feed requirements on pasture; young stock and breeding stock require more supplements than dry cows or mature steers. The carryover on winter pasture can be as low as 25 per cent of the previous season's growth without causing depletion of the vegetational cover.

Stocking a pasture to its estimated carrying capacity does not insure that grazing will be uniform. It has been pointed out that more uniform grass utilization can be secured if watering sites are not over 2¼ miles apart. Likewise, salt can be distributed to influence the movement of cattle and thus the use of vegetation. Salting sites should be at least one-quarter mile from watering sites and fences. They should be scattered, and with sufficient salt at each site for 30 to 40 head of cattle. A permanent salting site is not desirable, because an over-grazed condition develops around any attraction. By moving salt licks from over-utilized to under-grazed areas, a more even ultilization of the pasture can be obtained.

Records of land use in southern Saskatchewan show that there is a large acreage of land which was cropped at one time but is abandoned now. In some townships this condition does not exist, whereas in others up to 30 per cent of the total land area is so classified. With few exceptions these abandoned lands are unsuitable for wheat production, and should be used for either grazing purposes or hay production. Reseeding of these lands to cultivated forage crops is a profitable practice, because yields of 3 to 7 times that of native grasslands are secured. In addition, forage is produced which is more adapted to seasonal grazing and hay production than that grown from native species. Reseeded abandoned fields adjacent to farm and ranch headquarters will prove most useful to stockmen, but parcels at some distance should not be overlooked, because they can be considered as a source of reserve feed supplies.

Reseeding of depleted pastures improves the grass cover. This practice is recommended for depleted pastures which are important in the grazing operations, particularly those which are used for calving and lambing, for winter grazing, around watering sites and at other vital points. Cultivation to destroy native weed cover should precede seeding. Protection from grazing during the first year of growth is desirable but not essential.

The effects of manure on native grass pastures are twofold. The yield is increased by 100 to 400 per cent, and the vegetation contains more phosphorus.

Although the application of manure to large fields is impractical, it is recommended that all available supplies be applied on winter pastures or pastures reserved for special uses. An application of 10 to 14 tons per acre once every 10 years is suggested, but smaller amounts applied more frequently will have equally beneficial effects.

The success of maintaining native grass pastures in a thriving state depends on the balance between the feed supplies and the livestock population. Moderate grazing of pastures is the best method of maintaining a balance, while a supply of supplementary feed for all seasons of the year gives greater stability to the grazing industry.

Large-Scale Experiments

The investigational work with forage crops has been supplemented by large-scale experiments. These were conducted to test the practicability of forage crop production on soil types and under climatic conditions not available on experimental Station property. During the period 1937-1942 more than 600 of these experimental projects were established, mostly in co-operation with farmers and ranchers. In addition, the reseeding of abandoned farm land in community pastures tested to even a greater extent the principles of forage crop production. All projects were studied after stands were established. The results of those studies are presented.

RESULTS ON DRYLAND

Crested wheat grass was found to be the best grass to use for reseeding abandoned farm land, and depleted pastures on all soil types except within the Cypress Hills area. Firm seed-beds with a trash cover of stubble or annual weeds provided the best conditions for seeding, but good stands were secured on nearly all types of weed growth. The following list of plants is placed in order to indicate suitability as a cover in which to seed crested wheat grass: cereal stubble, Russian thistle, tumbling mustard, goosefoot, fleabane, Fendler's cryptanthe, blue bur, veined dock, pasture sage, prairie sage, goldenrod, tansy mustard, stinkweed, buck brush, and roses.

These observations indicate clearly that crested wheat grass can be most readily established among the first weeds to occupy the land after abandonment. As the period of abandonment lengthens, the encroachment of perennial weeds makes it more difficult to secure stands of grass. Therefore, it is highly desirable to seed amongst stubble or within 2 or 3 years after the land has been left idle. It must be remembered that crested wheat grass competes successfully with perennial weeds, but it takes longer to secure a stand.

Stands of crested wheat grass can be obtained where rose bushes and buck brush are growing. Under such conditions it is necessary to mow the brush before seeding, and also to mow the area in subsequent years. The trash should be removed before seeding.

Depleted native pastures have been re-grassed successfully without previous cultivation. However, it was found to be beneficial to one-way or disk the land prior to seeding. These operations killed a part of the weed cover which reduced competition and loosened the surface sufficiently to permit penetration by the drill disks. Depleted pastures should be seeded during late fall just before freeze-up.

Although crested wheat grass gave the best results over most of the area, other forage crops were better suited to certain areas. Brome was found to be suitable within the Cypress Hills area and in localities where moisture conditions are better than average. Alfalfa and sweet clover in mixtures with grasses gave increased yields of hay, but when grazed the alfalfa did not remain in the stand for any appreciable length of time.

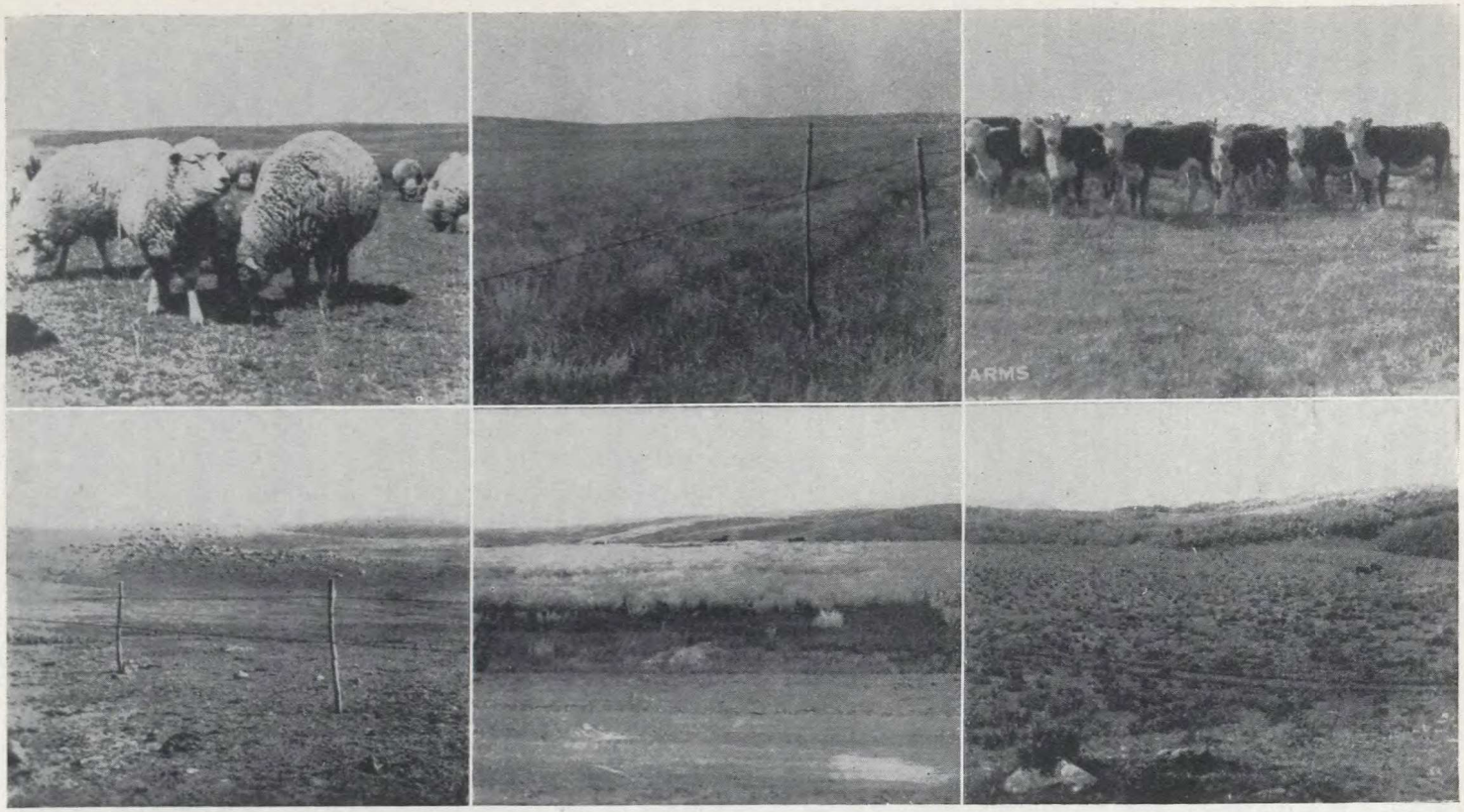


FIG. 16.—(Upper) Properly managed grazing lands. Short-grass prairie at left, mixed prairie at centre, and submontane prairie at right. Note the absence of weeds and the good cover of grass. The centre panel of this figure and the centre panel of the following figure were taken from the same point on opposite sides of a road and on the same day.

FIG. 17.—(Lower) Overgrazed native grass pasture. Short-grass prairie at left, mixed prairie at centre, and submontane prairie at right. Note the heavy weed cover in the centre and right panels and the depleted grass cover at left. The right panels of the two figures were taken the same day about ten miles apart.

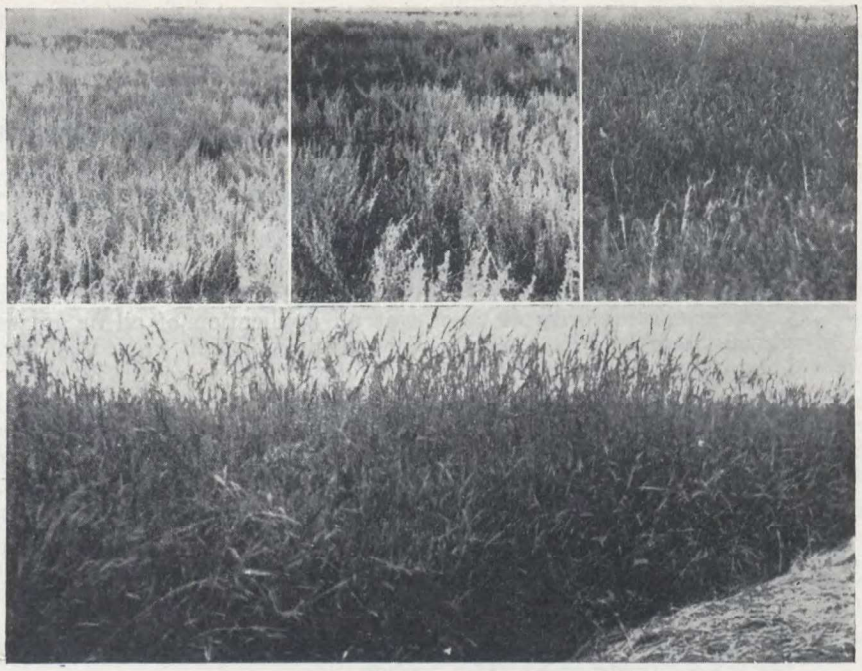


FIG. 18.—(Upper) Depleted grazing land reseeded to crested wheat grass. The panel at the left indicates the cover before seeding in 1936, the centre panel one year after seeding, while the panel at the right shows the complete stand in 1939. All pictures taken from the same point and on the same land.

FIG. 19.—(Lower) Reed canary grass growing on spring-flooded, low-lying land.

RESULTS ON MEADOWS AND SLOUGHS

Excellent stands of grasses have been secured on spring-flooded meadows and sloughs. While the methods of seeding and seed-bed preparation, which had been recommended, were found to be applicable generally, one very important exception became apparent, namely, that the land should be ploughed at least one year prior to seeding. Also that ploughing should be followed by seed-bed preparation. If any farmer or rancher is contemplating improving a low-lying area, it is recommended that he contact his nearest Experimental Station before doing so.

AGRICULTURAL ENGINEERING

DRAFT STUDIES OF FARM MACHINERY IN SOUTHWESTERN SASKATCHEWAN

An extensive series of tests was undertaken in 1938 to determine the draft of farm machinery as used by the farmers in southwestern Saskatchewan.

Draft data were obtained of different farm implements which were used on different soil types during the regular seasonal farm tillage operations.

Complete records of the name and size of tractor and implement, speed of operation, depth of working and mechanical condition of the implement, soil type, moisture condition, topography, and an indication as to the amount of vegetation were recorded for every test.

Conclusions drawn from these tests, based on the analysis of the information, together with accurate field observations, were:

1. The depth and speed of operation depended entirely upon the amount of power which the operator had available.
2. The majority of tractors tested were developing 60 to 75 per cent of their rated drawbar horse power.
3. The machinery in general was in fairly good mechanical condition. The operators realized the importance of sharp cutting edges on tools such as plough shares and cultivator shovels. Items such as bearings and braces were frequently neglected.
4. Very little machinery was kept under cover. The only protection given in the majority of cases was an application of oil or grease to plough mouldboards and cultivator shovels, which prevented rusting between jobs.
5. Large single implements required a great deal more power than multiple-hitched implements of the same width. This was probably due to the fact that the multiple hitch was more flexible and could follow the surface irregularities of the ground more readily.
6. The draft of implements which lift and turn the soil increased with an increase in speed.
7. The need for proper hitch adjustment was demonstrated in many cases. The draft of a four-bottom plough was decreased 10 per cent when the hitch was adjusted properly.
8. A small pony drill behind a plough increased the draft approximately the same amount as an extra bottom.
9. The draft of a single-disk drill was one-third greater than the draft of a double-disk drill of the same width.
10. The draft of every type of implement increased with each change in soil texture from light sandy loam to heavy clay soil. The increased draft varied with the type of implement.
11. The one-way disk was the favourite implement, irrespective of soil type. The variety of conditions under which this implement was used presents many problems. The size, concavity and the spacing of the disks, the depth and speed of working and the effective cutting width of the machine itself are very important factors to which very little attention has been given.
12. The need for a better balance between power and implement set-up on the majority of farms was indicated in this series of tests.

THE VACUUM GAUGE HORSE POWER RECORDER

The vacuum gauge horse power recorder was designed and built to secure complete data on horse power requirements of the various power take-off driven farm machinery and equipment under varying field conditions.

The need for an instrument of this kind is readily apparent, since the use of the power take-off on the farm tractor for the transmission of power to operate various farm machines such as binders, mowers, swathers and power take-off driven combines is rapidly becoming more widespread.

To date no satisfactory or practical field torque dynamometer or equipment is available by which data on horse power requirements under varying field conditions can be measured.

The principle involved in the vacuum gauge horse power recorder is as follows: the throttle valve opening is a direct function of the load on an internal combustion engine, with a governor controlled throttle operating at

rated crankshaft speed. The position of the throttle valve regulates the vacuum pressure in the intake manifold. Thus the vacuum pressure is directly related to the horse power developed by the engine. The vacuum pressure may be calibrated to the brake horse power developed by a tractor in a testing laboratory. Thus the values recorded in the field of the vacuum pressure under any load indicate the horse power developed by the tractor for the particular load.

HORSE POWER REQUIREMENTS OF VARIOUS TYPES OF POWER TAKE-OFF DRIVEN COMBINES

In order to secure more data on the horse power requirements of power take-off driven combines under varying field conditions and crop yields, an experiment was conducted with two common types of combines on fields with yields of grain varying from 5 bushels per acre to 35 bushels per acre on flat fields to fields with a 20 per cent grade and on three footing conditions to include (1) hard stubble land, (2) medium stubble land, and (3) soft stubble land.

The conventional type of combine used in this experiment had an 8-foot effective width of cut and a 24-inch rasp type rub bar cylinder. It was equipped entirely with roller chain drives, except a steel link chain reel drive and a Vee belt drive to the shoe and straw walkers. The machine was mounted on two rubber-tired wheels and weighed 3,125 pounds.

The high speed combine used in this experiment had a 5½-foot effective width of cut and a 5-foot rubber faced, angle iron type cylinder. It was equipped with all Vee belt drives, excepting two short steel link chains. The reel was ground driven. This machine was also mounted on two rubber tired wheels and weighed 2,739 pounds.

One tractor was used for all experimental work conducted with these two machines, thus eliminating any variation in power output which would arise had different tractors been used on each machine. The tractor had four forward operating speeds and was capable of developing a maximum of 30 h.p.

The special vacuum gauge horse power recorder was attached to the intake manifold of the engine and used to record the horse power developed by the tractor. One trip was first made around a field with the combine mechanism in operation. The gauge would record the power required to propel the tractor and the combine and to operate the combine for that particular crop and field condition. A second trip was made around the field without the combine mechanism in operation. The gauge would then record the power required to propel the tractor and combine. The difference between the two power recordings indicates the power necessary, in this particular crop, to operate the threshing mechanism through the power take-off mechanism. This set of tests was run with each combine at all four forward operating speeds of the tractor in all crop and field conditions encountered.

Conclusions drawn from this experiment after an analysis of the information obtained were:

I. 1. In a 30 bushel per acre crop, which is average, the power required to operate the combine mechanism and the power required to propel this particular tractor and combine is approximately the same on level land irrespective of forward speed of travel.

2. The amount of power required to propel the tractor and combine on rolling land under identical crop conditions was double that needed to operate the combine mechanism, irrespective of the speed of travel as the grade increased up to 15 per cent.

3. Also, one and one-half times as much power was necessary to combine a 40 bushel per acre crop than a 5 bushel per acre crop, irrespective of speed of travel on level land.

4. The need of a flexible system of tractor size recommendations is apparent if these machines are to be operated over even this range of field and crop conditions.

II. The power to operate the threshing mechanism of both machines through the power take-off is approximately the same over the average working range (20 to 30 bushels per acre crops). In view of the fact that the conventional type of machine had an 8-foot cut compared to the 5½-foot cut of the high speed machine, the power consumption per foot of width is definitely in favour of the conventional machine.

III. The difference in power of the two machines varies somewhat over the complete range of operating conditions. At the no-load limit, over twice the horse power per foot of width is required by the high speed machine, whereas at the 40-bushel per acre load limit, a maximum in this study, the horse power required is only about one and one-third times that of the conventional type.

The widespread use of initial horse power and the gradual convergence as the load is increased, may be due primarily to one of two major features in design or an accumulation of all. First, there is the probability that the difference is due mainly to cylinder designs. That is, the long 5-foot cylinder, although quite light in construction, requires extra horse power on no load due to its large cylindrical area. However, with its greater capacity, it is able to handle a larger volume of material. Second, there is a possibility that this spread may be partly due to the use of roller chains on the conventional machine and Vee belt drives on the high speed machine. These two features, namely, cylinder design and roller chain versus Vee belt drives are suggested as possible answers to the power discrepancy.

IV. The need for some type of independent power take-off clutch is essential, if satisfactory operation of the power take-off driven type of machine is to be secured under rolling land conditions.

PNEUMATIC TRACTOR TIRES

In June, 1933, the Dominion Experimental Station, Swift Current, Sask., purchased the first available complete set of 4-ply shallow diamond tread low pressure tractor tires in Western Canada.

During a 2-year period of general operation the rubber tire equipped tractor was used on all regular farm operations. In addition, a complete series of tests was conducted in 1936 to study the efficiency of pneumatic tractor tires in comparison to steel wheel equipment. During these tests the tractor was placed on severe overloads and light loads, with and without wheel weights and with high and low pressures. The pneumatic tire equipped tractor was stored outside in winter and in summer in order that the tires would be exposed to the severest of weathering conditions. No preservative treatments were applied to the tires at any time.

The complete set of tires was used on the same tractor for an 8-year period, resulting in 5,434·0 hours of tractor wear for the rear tires, and 5,338·0 hours for the front tires before replacing.

RUBBER TIRES ON FARM IMPLEMENTS

The use of rubber tires on many of the common farm implements is increasing very rapidly.

A detailed study to compare the draft of a one-way disk on rubber with a one-way disk on steel, operating under the same field conditions, shows a reduction in draft up to 15 per cent. Furthermore, greatly improved depth control is made possible with the use of rubber tires on a one-way disk.

The majority of recent farm implements, which include ploughs, one-way disks, cultivators, seed drills, mowers, swathers and combines, are available with rubber tires as standard equipment.

In many instances, farmers are converting their regular steel wheel equipment to rubber.

Tillage Machinery

Tillage operations should be confined to the minimum which will attain the following objectives:

(1) Moisture conservation.
(2) Weed and insect control.
(3) Soil erosion control.

Weed and insect control can largely be obtained with the same tillage operations if these are properly timed. The quality of the work done depends largely upon the timeliness of the operation, soil moisture content, and the condition and the adjustment of the machine.

Tillage machinery investigations have been confined to the study of soil drifting and trash cover implements. Modern and up-to-date improvements of proved and accepted tillage machines are being offered, and this is to be highly commended by all concerned. However, new tillage machines and radically different methods of tillage are being studied to determine their practical application to each individual area.

LAND PACKERS

To obtain more complete information on various types of commercial and home-made land packers when used in conjunction with the one-way disk and seeding attachments, an experiment was conducted with different packers on different soil types and on summerfallow and stubble land.

Conclusions drawn from this experiment after an analysis of the information include:

1. Surface packers have proved very unsatisfactory, since they tend to smooth down lumps and protective trash that may have been left on the surface and pack only the surface of the soil which, in many cases, would tend to start an immediate weed growth and subsequently choke out the crop.

2. Subsurface packers have proved to be very satisfactory, since they tend to firm the soil below the surface and pack the soil particles around the seed without disturbing more than a minimum surface area.

Note: Subsurface packers are classified as those with Vee-and disk-type blades.
Surface packers include rollers, pipe, crowfoot, cultipacker, etc.

ONE-WAY DISK

The one-way disk came into general use during the time when tractors were commonly built for slow working speeds. The introduction of higher working speeds in tractors has resulted in the operation of the one-way disk at speeds far in excess of what the implement was originally designed for. On the basis of 22 years' work with the one-way disk at Swift Current, conclusions have been drawn as follows:

1. The conventional one-way disk used in southwestern Saskatchewan at high speeds greatly pulverizes dry soil and throws the trash clear. When operated in proper adjustment and at the recommended speed of 3 to 3½ m.p.h. the trash is left well anchored and in an upright position suitable for the highest degree of efficiency relative to both wind and water erosion control.

2. The one-way disk used in southwestern Saskatchewan will work in a wide range of soil and moisture conditions. The disk spacing, disk radius of curvature, and disk diameter, which may be selected for any one-way disk, will determine the degree of effectiveness of this machine for the major variations in soil type and farming conditions for which it is best suited.

3. The importance of the proper hitch adjustment of the one-way disk cannot be over-emphasized. When the hitch is adjusted correctly to suit the operating conditions under which the work is being done, most of these machines will do a good job of tillage.

ONE-WAY DISK HARROW

The one-way disk harrow was originally built by farmers, local blacksmiths and machine shops in the open plains area of Western Canada. It was designed in an attempt to make a machine that would move soil and stubble in one direction, making a complete shallow cut and effectively anchoring the trash and leaving the land free of ridges which are usually found when using the out-throw or in-throw single disk harrow. This machine has been under close observation for several years. When operated at speeds no greater than 3½ m.p.h. the quality of tillage in all instances is superior to the out-throw or in-throw single disk harrow. These machines operate successfully on large fields, the topography of which does not exceed gently rolling.

The powers requirements per foot width of cut of this machine compare very favourably with the power requirements of a conventional single disk harrow when operating under similar conditions.

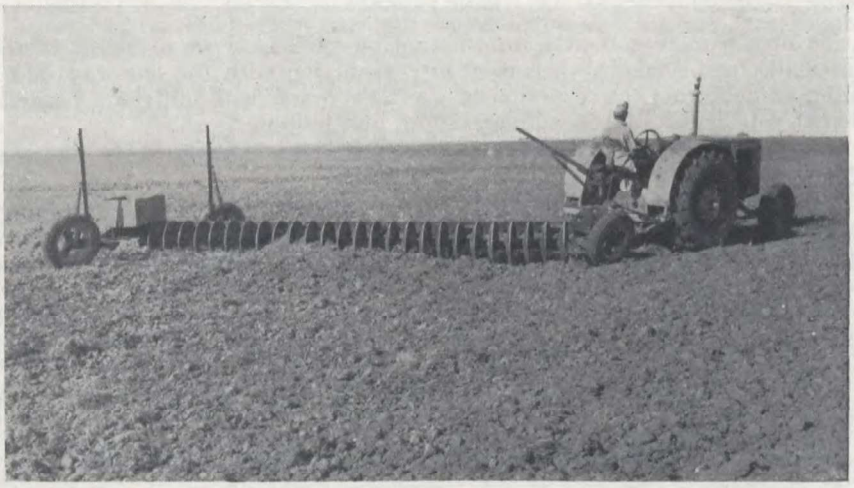


FIG. 20.—Krause plow in operation at the Dominion Experimental Station, Swift Current, Sask.

BLADE MACHINERY

Several types of blade machinery have been studied as an aid to prepare stubble mulch summerfallow in widely different soil types and separated moisture conditions.

Three different types of blade machinery were studied:

(1) Noble blade with cultivator sweeps and straight blade attachment.
(2) Williamson blade with single Vee blade.
(3) Erdman blade with three cultivator sweeps.

Conclusions on the basis of an extensive series of tests include:

1. Blade machinery is highly efficient in leaving a lumpy surface with stubble and trash remaining in an upright position, and may be used for a number of repeated operations on summerfallow and still retain the trash cover.

2. The trash clearance on blade machines is an excellent feature for satisfactory harvest tillage operations immediately behind the combine harvester to prevent the maturing of Russian thistle or other fall weeds.

3. Blade machinery may be used on relatively stony land without danger of serious damage.

4. Blade machinery should be regarded as highly specialized tillage implements, since they cannot be used as easily and as readily as can the disk-type tillage implements. At present their recommended use is confined to the light brown soil zones of southern Saskatchewan and southeastern Alberta.

5. Prerequisites for the successful operation of present blade machinery include:

(*a*) Dry, firm soil.
(*b*) Hot, dry weather conditions for a rapid weed kill.
(*c*) Fields must be relatively free from ridges.

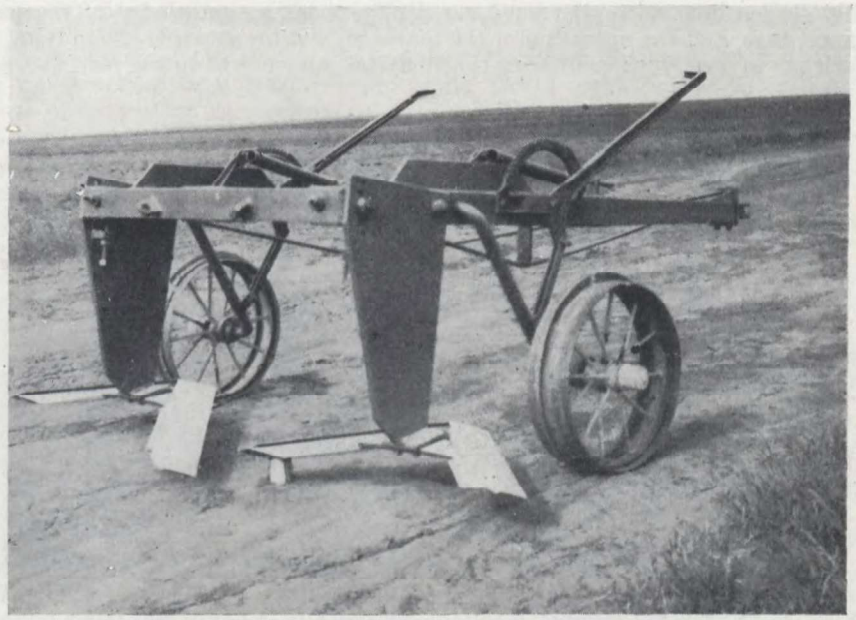


FIG. 21.—Noble blade with cultivator attachments.

GRAIN HARVESTING MACHINERY AND EQUIPMENT

HIGH SPEED POWER TAKE-OFF DRIVEN COMBINES

High speed combine investigations have been confined to studying the relative efficiency of these machines. It was found that it was possible to cut very close to the ground with these machines. Furthermore these high speed combines have a very high threshing efficiency if operated at forward speeds between 5 and 7 miles per hour. High cylinder speeds make it impossible to

travel at speeds below this range if excessive grain cracking is to be prevented. Horse power requirements studies of power take-off combines show a very flexible need of tractor sizes and speed recommendations if the combines are expected to operate with a high threshing efficiency over a range of field and crop conditions that may be expected in the wheat-growing areas of Western Canada.

SELF-PROPELLED COMBINE HARVESTER

Self-propelled combines have been under observation since 1930. Operational advantages such as convenience, flexibility, portability and one operator per machine, favour the use of the self-propelled combine harvester. In addition, there has been a trend towards increased custom work due to the high initial cost and the apparent scarcity of this type of grain harvesting equipment. Furthermore, the general trend towards the increase in size of the individual wheat growing farm units, favours the self-propelled combine.

Self-propelled combines, which are available at present, are capable of handling a large volume of grain and straw. When they are in proper adjustment to meet with existing field conditions, this type of combine has a relatively high threshing efficiency.

Satisfactory performance of the self-propelled combine is dependent upon highly skilled operators, who have a complete working knowledge of the maintenance, care, and the operation of the machine, and are capable of applying this knowledge to meet with conditions that may be encountered in the field operating conditions.

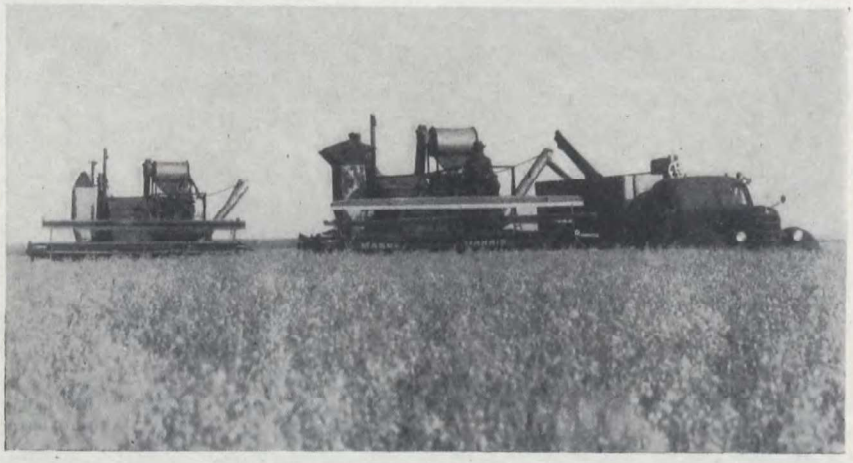


FIG. 22.—Self-propelled combines combining oats at Rush Lake, Sask.

SPECIAL CROP ATTACHMENTS

Special Pick-Up Finger Attachment for the Combine Harvester.—Pick-up finger attachments for combine harvesters have been under observation for some years. With the ever increasing severity of sawfly damage in grain crops, special investigations with pick-up finger attachments were conducted in 1943. These pick-up finger attachments did not prove to be of any value on short, light crops that were heavily infested with Russian thistle. The fingers were long and pointed abruptly towards the ground, hence the combine cutting bar mechanism had to be raised to prevent the fingers from running into the ground, and

many short stems and heads of grain remained untouched. Furthermore, with the special fingers attached, the reel does not have the same cleaning effect on the cutting bar mechanism. This is especially evident where Russian thistle is prevalent. The Russian thistles would drag and prevent many heads of wheat from being cut.

In heavy, clean stands of grain where sawfly damage was severe and the damaged plants were held up by adjacent plants, the pick-up fingers worked reasonably well.

Special Pick-Up Reel.—Special pick-up reel attachments have been under close observation for several years. Special pick-up reels are adaptations of the "pea reel" or comb-type reel which has steel spring fingers placed on the lower side of the reel slat, with the slat pivoted on each end and controlled by an eccentric which gives the fingers and slats a one-third to one-half circle motion during its travel from the point of meeting the grain to delivery on the combine table. This reel actually sweeps the ground and is particularly successful where a very large percentage of the crop is lying flat on the ground. Exceptionally high recoveries have been secured with some of these attachments.

These pick-up reels may be used on combine harvesters or on the header barge setup.

HARVESTING OF SUNFLOWERS WITH THE COMBINE HARVESTER

An extensive and thorough series of trials was conducted in 1942 to determine the practical application of the conventional combine harvester for the purpose of harvesting sunflowers.

Conclusions drawn from this series of tests were:

1. Certain designs of combine harvesters are unsuitable unless some special attachments are used.

2. Other designs of combine harvesters are suitable to handle a crop of sunflowers quite satisfactorily with but minor adjustments.

3. Cylinder speed must be slowed down to one-half the regular revolutions per minute while the remainder of the threshing mechanism must operate at the regular speed.

4. With the reduction of the cylinder revolutions per minute, the capacity of the combine is reduced and the forward speed of travel must also be reduced at least one gear slower than usual.

5. Fully covered with slats or fine wire mesh, extension reel arms forming an angle of 30 degrees with the back of the original reel arms and extending a distance at least 18 inches are required to prevent the sunflower heads from hooking on the regular normal reel slats.

6. Speed of the reel arms should be reduced slightly to prevent the sunflower heads from being thrown clear of the machine.

7. Height of reel arms should be such that the centre is somewhat above the average height of the sunflowers and be placed so that the stalks are held by the reel slat just before they are cut by the knife.

8. Special attention should be directed to the adjustment of the adjustable chaffer and the adjustment of the air louvres for satisfactory cleaning of the seed.

HAY

POWER MOWERS

Extensive trials with (1) drawbar mounted, (2) trailer mounted, and (3) semi-trailer mounted power take-off driven mowers were carried out on large hay meadows in the Cypress Hills area and on the large irrigation projects in southwestern Saskatchewan.

The purpose of these trials was to obtain information on the performance and quality of work of these mowers at different speeds of travel.

These mowers worked quite satisfactorily when travelling at four miles per hour. When travelling at speeds of seven miles per hour, a clean cut could be obtained but the height of cut would not be uniform, since the high speed of travel would cause the tractor and mower to bounce severely when working on native hay meadows. When working on areas free from ridges or holes, a clean uniform height of cut could be obtained. When working at speeds of two miles per hour, the cut hay would not clear off the cutter bar causing the cutter bar to plug.

The drawbar mounted and the semi-trailer mounted power take-off driven mowers are much handier when operating in confined areas where short right turns are encountered.

RAKES

Dump or sulky rakes and side-delivery rakes have been under close observation for a number of years. These machines are definitely slow-speed machines, and any attempt to use this equipment at high speeds will result in frequent breakdowns requiring major repairs.

The introduction of pick-up balers has brought the side-delivery rake into the foreground. For satisfactory operation of the pick-up baler, uniform, well cured windrows, reasonably straight and free from sharp breaks, are required. The action of the dump or sulky rake on wilted hay is such that the material is dragged and pushed into a compact mass. The action of the side-delivery rake on similar material actually rolls the material into loose, uniformly straight windrows.

COMBINATION SWEEPS AND STACKERS

Various types of combination sweeps and stackers have been under very close observation for a number of years. During the past four years, because of the serious labour shortage and the lack of suitable hay handling equipment, ranchers and farmers have built tractor-mounted combination sweeps and stackers to suit their own specific needs.

Several types of commercial models of tractor-mounted combination sweeps and stackers have been tested under conditions which would be normally encountered during regular hay handling operations in order to determine the practical application of these machines.

All models were satisfactory on cultivated hay areas. On native hay areas such as meadows or areas where numerous pot-holes were encountered, this equipment required constant repairing and strengthening of parts.

On irrigated areas, where the fields were well prepared, one man with a tractor mounted sweep and stacker could readily sweep and place up to five tons of hay per hour into the stack.

PICK-UP BALERS

An experiment was carried out and extended over a period of several years to determine the practical application of pick-up balers for the purpose of handling hay in southwestern Saskatchewan.

Types of machines used include:

1. Auxiliary engine driven, manual tying with wire, employing two or three men to set the blocks, thread and tie the wire, and an operator to operate the tractor for hauling the machine.

2. Auxiliary engine driven, fully automatic tying with a special baler twine, requiring only one man to operate the complete unit.

Tests were carried out on fields that were in cultivated hay crops and fields in native hay meadows.

Accurate records on total number of bales, total number of tons, total hours of operation per haying season, total amount of twine or wire that was used, and also an accurate listing of repairs and repair work were kept.

Conclusions drawn from this experiment, based on the information obtained, together with daily records on hours of sunshine and inches of rain were:

1. The high initial cost of this equipment is an undesirable feature except for the large rancher, farmer or commercial hay producer who plans to haul or ship the hay some distance.

2. No definite cost figures on basis of cost per bale or cost per ton can be stated. It is definitely recognized that local conditions in any specific area have a decided influence on the cost of pick-up baling operations and will, therefore, be an important factor in calculating the cost per bale or cost per ton. These local conditions include such factors as:

(*a*) Yield of hay and kind of hay in tons per acre. Low yields are usually associated with high costs and high yield with low costs within certain limits.

(*b*) Size and topography and location of hay fields.

(*c*) Weather conditions during the haying season.

(*d*) Condition of equipment and experience of the operator.

These variable factors will not alter calculations if the cost per hour basis is used. These variable factors will, however, enter the picture only when computing the cost per acre on ton or bale basis. Publication 749, Circular 174, Dominion Department of Agriculture "Basic Rates for Custom Work Charges" has been used as a basis for calculating the cost of pick-up baler operations. It is felt that in presenting any data on cost only such factors as interest, depreciation, repair charges and operating expenses such as fuel, oil, grease, and labour should be used. Therefore, the profit factor as indicated in Basic Rates for Custom Work Charges has been dropped. Table 33 gives a complete summary of cost data for picking up and baling hay with a New Holland Automaton baling press using a Model "C" Case tractor to haul the machine.

TABLE 33.—SUMMARY OF COST AND YIELD DATA FOR 1945, 1946 AND 1947 FOR PICKING UP AND BALING HAY WITH A NEW HOLLAND AUTOMATON BALING PRESS

	—	1945	1946	1947
1.	Acres, accurate estimate	272·0	152·0	250·0
2.	Tons, actual weight	255·1	158·0	207·0
3.	Bales, actual number	8,673·0	5,372·0	6,948·0
4.	Average weight per bale in pounds	60·0	60·0	60·0
5.	Yield in tons per acre	·94	1·04	·83
6.	Hours of operation	135·0	71·0	167·0
7.	Rate of baling in tons per hour	1·89	2·23	1·24
8.	Rate of baling in bales per hour	64·2	75·6	41·6
9.	Total amount of twine in pounds	663·3	410·8	538·2
10.	Pounds of twine per ton	2·6	2·6	2·6
11.	Total cost of twine	$ 99.42	$ 89.34	$131.86
12.	Cost of twine per pound	.15	.22	.25
13.	Cost of twine per ton	.39	.57	.65
14.	Cost of operation (less twine)	$515.29	$273.35	$639.55
15.	Cost of operation (plus twine)	$614.71	$362.69	$771.41
16.	Cost per ton	$ 2.41	$ 2.30	$ 3.73
17.	Cost per bale	.07	.07	.11
18.	Cost per hour to operate outfit (less twine)	$ 3.82	$ 3.85	$ 3.83
19.	Cost per hour to operate outfit (plus twine)	$ 4.55	$ 5.11	$ 4.62

3. Hay, which is to be baled with a pick-up baler from the windrow, must be field-cured to a moisture content of approximately 20 per cent (dry weight basis) and baled at a density of 9 to 10 pounds per cubic foot to prevent caking or spoiling. At this density and moisture content, bales will withstand a reasonable amount of handling. Baling hay at a moisture content far below 20 per cent makes it almost impossible to tie a tight, firm bale, and causes excessive leaf shattering (alfalfa) and breaking up of stems.

4. There are many limitations and problems remaining to be solved.

(*a*) Hay harvesting like harvesting grain with the combine harvester must be done in a very limited time.

(*b*) Any one machine can serve only a limited number of acres.

(*c*) The pick-up baler merely packages the hay and deposits the bale on the ground. A great deal of manual labour is required to gather and load the bales up into a truck, trailer or wagon and subsequently place the bales into storage. Field pick-up bale loaders and bale elevators are available to eliminate much of the hand labour.

5. The ease and convenience for handling baled hay from storage during the winter months, as compared with handling loose hay, is readily apparent.

6. The pick-up baler may be used for picking up and baling wheat, oats, barley or flax straw as left in the windrow by the combine harvester. The pick-up baler may also be used effectively for stack baling of hay or straw during off seasons.

7. Custom work with pick-up balers does not appear to be very satisfactory. Too frequently the owner of the machine is interested in the number of tons or bales that he can handle. Consequently, quality will suffer because of quantity. On the other hand, with a privately-owned machine the owner may handle his hay when it is in the best of condition.

FIG. 23.—New Holland twine-type automatic tying pick-up baler at the Dominion Experimental Station, Swift Current, baling alfalfa hay.

COST OF OPERATING FARM TRACTORS, FARM MACHINERY AND FARM EQUIPMENT

The increased mechanization of farming operations in the Prairie Provinces has demanded specific data on cost of operating farm tractors and machinery.

Accurate records on all types of farm tractors and farm machinery and equipment at the Swift Current Station over a period of many years has made it possible to work out a method that may be readily adapted to the majority of farm enterprises in Western Canada.

Conclusions drawn after a complete analysis of the information were:

1. The cost should be determined on the hour basis. The acre method shows very large variations between soil types but only very minor variations on the cost-per-hour method.

2. The life estimate for farm tractors and machinery has been established as follows:

Tractors	10,000 hours
Tillage machinery	3,000 "
Seeding machinery	2,000 "
Harvesting machinery	2,000 "

3. Repair charges on the new value for different machinery over their established life period should be:

Tractors	80 per cent
Tillage machinery	100 " "
Seeding machinery	150 " "
Harvesting machinery	150 " "

4. Depreciation charges should be based on the actual hours of use per season.

5. Interest charges should be charged against the machine for the money invested.

The repair, depreciation and interest charges are regarded as basic costs. In addition to these basic costs, there are the operating costs which include fuel, oil, and grease and labour costs. Thus the basic cost, plus operating cost, plus labour cost, makes up the total charge per hour.

BASIC COST RATES FOR CUSTOM WORK CHARGES

The following basic cost rates, which may be used in calculating custom work charges for farm power and machinery, are suggested after a careful study as a sound basis upon which uniform and equitable custom charges for farm equipment may be calculated.

It is recognized that local conditions have a decided influence on the cost of field operations and will, therefore, be an important factor in calculating reasonable and equitable custom charges. Some local conditions influencing custom charges include: topography or roughness of the fields, stoniness, soil texture, moisture conditions, and the size of the fields. However, these variable factors will not alter the hourly basic cost figure, but come into the picture only when computing the rate on an acreage basis because of the variation in the acreage covered per hour under these varying conditions.

The custom work charge for each machine is made up of three distinct parts:

1. Basic cost rate.
2. Operating costs.
3. Labour costs.

The basic cost rate is relatively constant for any machine under all conditions. Operating cost and labour cost will vary with each locality and working conditions. Therefore, the operating costs and labour costs should be worked out separately for each machine and season.

All basic rates for use of farm power and machinery include the cost of depreciation, interest, normal repairs and upkeep, and a reasonable charge for

the risks and other factors involved in doing custom work. Such risks and other factors include short moves between jobs, financing, fuel and other costs, collections, bad debts, and others.

To this basic rate it is necessary to add operating costs per hour in order to arrive at the total custom charge per hour.

Operating costs include cost of fuel, oil, grease and labour, all of which vary in different districts, and the actual costs prevailing for each item in that district should be used when working out operating costs.

The above basic cost rates may be used for the rental of all machines (with the exception of the tractor), with no power or labour supplied. In the case of the tractor, the basic cost figure should be increased at least 50 per cent to cover the added risk involved when the owner is not directly responsible for the operation of the tractor.

It is strongly recommended that the hour basis be used for all custom work charges, as it has been found to be the most uniform and equitable method where wide fluctuations in local cost and operating conditions are common from season to season and year to year. If it is found necessary to convert the above hourly costs into an acreage basis, every operator will be able to do so very quickly. Every farmer knows exactly how many acres his outfit will cover per hour of work. By dividing the number of acres covered per hour into the total custom charge rate per hour for that outfit, the result will be the cost per acre.

Full details, together with examples of sample calculations for tractors, tillage machinery, seeding machinery and harvesting machinery, are available in the Dominion Department of Agriculture Publication 749, Circular 174, Basic Cost Rates for Custom Work Charges (for the Prairie Provinces).

Dugouts

Dugouts are becoming increasingly popular as a means of water supply for domestic stock watering and irrigation purposes. They, as well as dams, are a very successful method of storing spring run-off water to be used throughout the year.

There are several points to be considered when planning and constructing a dugout, whether it be for all three purposes just mentioned or for any one of them. A site should be chosen which will be convenient and easily accessible for the purpose required. A drainage area of not less than 35 acres should be tributary to it. This may be lessened somewhat if snow fences or shelterbelts are provided to cause an extra accumulation of snow. The dugout should be so located that the watershed is free from possible pollution by animals or humans.

The subsoil of the site is very important. Drillings or test holes, with a post-hole auger, should be made to determine the type of subsoil beyond the depth of the dugout. Clay or a good clay mixture is necessary, as a sand or gravel subsoil will not hold water.

The depth of the dugout is important, particularly if a year-round supply of water is required. A minimum of 12 feet is required, and preferably it should be 14 feet. Approximately 3 to 4 feet of the water may be expected to be lost through evaporation and seepage.

Some typical sizes and capacities are as follows:

Size		Excavation Cubic Yards	Full Capacity Imperial Gallons
100′ x 60′ x 12′	(sides—1½:1 slope) (ends—4 :1 slope)	1,099	185,000
120′ x 60′ x 12′	"	1,472	248,000
150′ x 70′ x 12′	"	2,485	418,000
120′ x 60′ x 14′	"	1,498	252,070
150′ x 70′ x 14′	"	2,591	436,980

The effective capacity will be about ⅔ the full capacity due to seepage and evaporation losses.

Dugouts 120 by 60 by 12 feet will give a daily supply of approximately 450 gallons.

The dugout must be tightly fenced to keep out all forms of animal life, domestic and wild. This is particularly so if the water is to be used for domestic purposes.

The accumulation of organic matter in the dugout is definitely to be avoided as much as possible. Trees and shrubs should not be planted closer than 100 feet from the dugout. Willows, etc., must not be allowed to grow along the water's edge. The reason for this, and tests have borne it out, is that a layer of organic matter, on the bottom of the dugout, if it is allowed to collect, forms a favourable situation, through bacteria and decay, for the iron in the soil to become soluble. If this occurs, the water at the bottom of the dugout will contain a very high iron content. This situation is poor if the water is to be used for domestic purposes.

If the dugout is to be a stock watering facility, arrangements should be made to instal a pump and supply water to a trough outside the dugout fence. For domestic use of the water, reference is made to the paragraphs below on "Filters".

FIG. 24.—Sand, gravel, and rock filter in place at bottom of a dugout. Filtering water for the domestic water supply in the house.

FILTERS—DOMESTIC USE OF SURFACE WATER

Filters are required wherever surface water supplies are to be used for human consumption. Continuous tests on filter installations at Swift Current indicate that a submerged type of slow sand filter is the most satisfactory. The filter is contained in a wooden or concrete container about 5 feet wide, by 5 feet deep and 10 feet long, and is located in the bottom of the dugout at the end closest to where the water supply is required. The filter element is composed of a one-foot layer of coarse gravel, $\frac{1}{2}$ to $\frac{3}{4}$ inch size, followed by a three-foot layer of well graded, clean, sharp concrete sand. A layer of 2 to 3 inch stones is placed on top. The filter should be completely enclosed except for a single screened 6-inch pipe inlet near the top on the dugout side. A six-inch cast iron pipe is

laid from the bottom of the filter to a well beside the dugout. The filtered water may then be pumped from the well for use as required. The usual precautions are required to prevent pollution entering the well. The well must have a water-tight cribbing and a tight, raised, sloping cover.

No filter will remove all the bacteria, but if prior precautions are taken to prevent pollution from entering the dugout or well, this type of filter will prove highly satisfactory with a minimum of attention and maintenance.

USE OF SPRING RUN-OFF WATER

Dams and dugouts are dependent on spring run-off water for their supply, but another means of utilizing this otherwise waste water is through spreading or impounding it to flood cultivated or pasture lands.

Cultivated Land.—To utilize run-off water on cultivated land, it is necessary to impound it rather than spread it as the latter may cause considerable washing of soil. Because the ground is usually frozen in the spring, more moisture will penetrate into the soil if impounding is carried out.

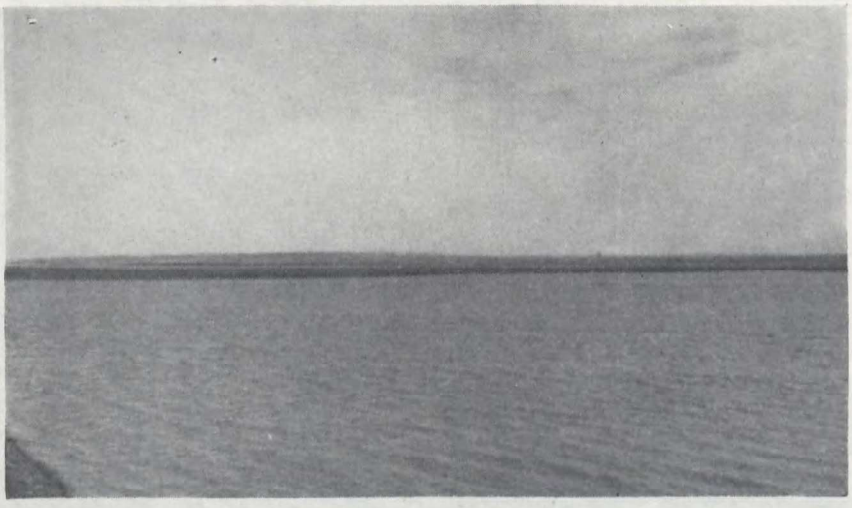


FIG. 25.—Dykes retaining spring run-off water on cultivated land.

Results of experiments have indicated several important points to be considered.

1. Flooding by impounding dykes of cultivated land will double and sometimes triple the yield of grain over non-flooded land.

2. The capital cost of dykes and other structures must be considered in relation to the area flooded and the yield which may be expected.

3. Flat and level land is required for a small investment cost per acre of land flooded.

4. A source of run-off water is required and, if this is available, a control on the amount of water entering the dyking system is essential. In addition, where all the water is not required to fill the dykes, provision must be made to by-pass the excess water through a suitable series of gates in the dykes or through the diversion which supplies the water to the system. There are instances where

the amount of water available is only sufficient to fill the system and, in these cases, the precautions for by-passing are not necessary.

5. Impounding dykes should be as straight as possible to facilitate farming operations.

6. The dykes cannot be farmed over and should be sown to grass. This will prevent washing and will assist in weed control.

7. Dykes, which impound more than 18 inches of water (in the case of moist soils), should be provided with a means of draining off the water after flooding has taken place for 10 days or two weeks. Maintenance is required on any dyking system.

8. No system is entirely automatic, and all will require the attention of the operator during the run-off period.

Pasture Land.—Impounding dykes may be utilized on hay meadows or flat and level pasture land in the same manner as they are on cultivated land. Best returns are available if the original sod is broken and cultivated forage crops seeded.

Dykes which do not impound but only spread water are of considerable value on land which is too steep to flood. This is particularly so when utilizing the surplus water from a dam spillway. Diversion dykes are useful in carrying surplus spillway water to an area below the dam where it may spread out and be of some use. Contour furrows are also of assistance in this instance for spreading, but have proved to be of little or no value in southwestern Saskatchewan and southeastern Alberta for conserving moisture when used without a supply of water.

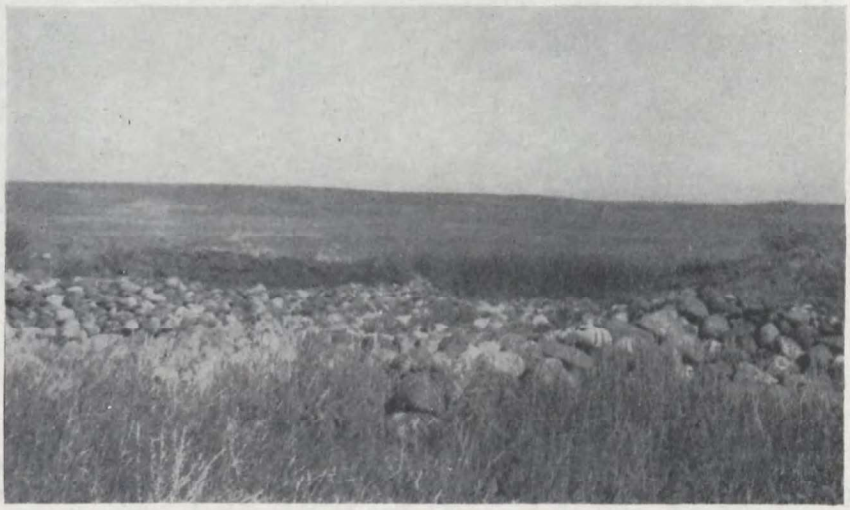


FIG. 26.—An opening in a dyke which diverts surplus water from a dam spillway and spreads it over the slope. Note the rank growth.

WATER EROSION CONTROL

Damage to prairie agricultural lands through water erosion has accelerated and become more apparent the last 12 years. This form of erosion is the process of soil washing by water, a result of rains or spring run-off. The more intense the rain or run-off, the greater the eroding power of the water, and consequently the greater opportunity for water erosion damage.

Water erosion is not generally the spectacular sight that wind erosion is. However, in severe instances, it may become more so. There are three main types of water erosion:

1. Sheet erosion, where the very top surface of the soil was washed from the slope. This type may not be observed for many years, but nevertheless it occurs when conditions are favourable to it and a general deterioration may occur.

2. Rill or finger erosion, where miniature gullies or grooves appear on the slope and the soil from these is washed to the bottom of the slope.

3. Gully erosion, where gullies are washed across the field.

Generally speaking, wherever there are long slopes the soil is most subject to water erosion, particularly if the subsoil is of an impervious nature.

FIG. 27.—Water erosion damage. Note the shallow top soil and the exposed clay and stone. The top line indicates the original surface.

In the control of water erosion, there are two main considerations:

1. To retain the run-off water, both from rain or snow, where it occurs. That is, do not permit it to accumulate to flow down the slope but have it penetrate into the soil.

2. In the instances where the accumulation is so great that it cannot be retained, then it should be permitted to flow down the slope in an orderly fashion in such a manner that damage will not result.

Trash cover or stubble mulch tillage, as in the case of wind erosion, is probably the greatest single weapon that may be used to combat water erosion on the prairies. In this manner, by adding cover and organic matter much can be attained towards increasing the penetration of moisture. If the subsoil is very impervious, it can often be corrected through the growing of legumes to open it up.

Experiments on contour farming are not complete but indications are that this method of farming or "across the slope tillage" may be beneficial in preventing loss through run-off flowing down the slope.

Dykes have been found to be of assistance in preventing erosion. The principle here is to prevent an accumulation from flowing down the slope by holding it at the top of the slope on more level land.

Diversions are useful in preventing an accumulation of run-off water from flowing across a field, but here the diversions and the new path of flow must be protected by sod-forming grasses in order that new erosion channels are not created.

In the more serious cases of gully erosion, where the gullies are beyond normal control and the fields are being cut up, it is desirous to reclaim these and prevent further gullying. In these cases the ragged channels may be shaped, saucer fashion, and seeded to sod-forming grasses. One-way disks or blade graders are effective in shaping the channels. Care should be taken to maintain an even depth of channel and a good width in order that it will not overflow during the next run-off period. These new channels may be crossed with farm implements but should not be torn up in the process. Maintenance is required in the form of cutting the grass and repairing small washes which may occur.

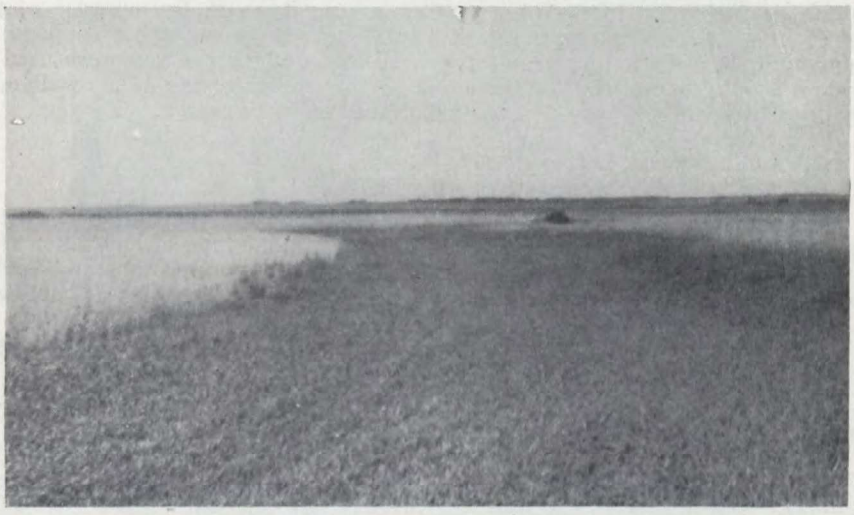


FIG. 28.—A former gully now well protected. This grassed waterway prevents additional damage and makes it possible to cross a formerly bad gully.

SPECIAL SECTIONS

FEED RESERVES

The establishment and maintenance of adequate feed reserves constitutes one of the key factors in successful livestock production throughout south-western Saskatchewan. Livestock producers suffered heavy losses in the 1930's as a result of severe drouth, coupled with hard winters. Thousands of tons of feed had to be imported from the United States and other Canadian provinces and, in spite of these importations, there were heavy death losses and additional forced marketings of livestock that were in no condition to sell.

VARIOUS KINDS OF FEED RESERVES

Feed reserves may take the form of reserve pasture areas for both winter and summer use, supplies of stacked roughage—either hay or straw, stocks of grain, silage, or concentrates such as oilcake. An adequate supply of feed reserves such as these helps to cushion the effects of the dry years and hard winters that are bound to occur from time to time.

STRAW STORAGE

Straw from cereal grains is the most prevalent form of roughage to be found in southwestern Saskatchewan, and the Swift Current Station has carried on considerable experimental work with the objective of determining the best method of storing straw. Wheat and oat straws were baled and stacked as well as being stacked loose. Costs as carried out in 1939 amounted to $1.95 to $2.19 per ton for straw baled and stacked in well-built, 20-ton stacks. The cost of stacking loose straw in an equally well-built stack amounted to $1.31 per ton.

After being stored for six years, chemical analyses showed that there was no siginficant depreciation in the nutritive value of the straw, and when fed to livestock it was found to be quite palatable. Spoilage on the exterior of the stack of baled straw was negligible, while there was considerable spoilage on the outside of the stack of loose straw. Five tons of loose straw were used to provide a weather-proof top for the stacks of baled straw, and as a result none of the top bales suffered any damage from moisture penetration.

HAY WELL-STACKED KEEPS INDEFINITELY

A 16-year-old stack of bluejoint hay was sampled to determine its nutritive value as compared with one-year-old samples of the same kind of hay taken from the same field. Chemical analyses showed the content of protein and carbohydrates to be approximately the same in both cases. When fed to livestock the 16-year-old hay was fully as palatable as the freshly-cut hay.

Large well-built and well-topped stacks of hay or straw are preferable. A certain amount of hay on the top of old stacks is spoiled on account of weathering, and the percentage of the feed that is spoiled from this cause is much greater on small, poorly-built stacks.

Russian thistle hay is a useful emergency feed that has kept countless numbers of stock alive during critical periods in the past 10 years. Tests have determined that the Russian thistles should be cut for hay before the spines become well developed and hard. Cut at this stage, it can be handled and stacked like ordinary hay. Best results are secured if 50 per cent straw or other hay is fed along with the Russian thistle hay. This reduces the laxative effect of the feed.

A glance at the history of livestock production in southwestern Saskatchewan emphasizes the fundamental importance of reserve feed supplies. While the stockman may be said to be a servant of the seasons, the effects of this servitude can be materially altered to the benefit of the stockman if proper attention is paid to the necessity of maintaining adequate feed reserves.

Land Use Study

The problems of rehabilitation have been many and varied in Saskatchewan. The ultimate objective of all experimental work at the Swift Current Station is to obtain the better use of land. In 1945, the Saskatchewan Department

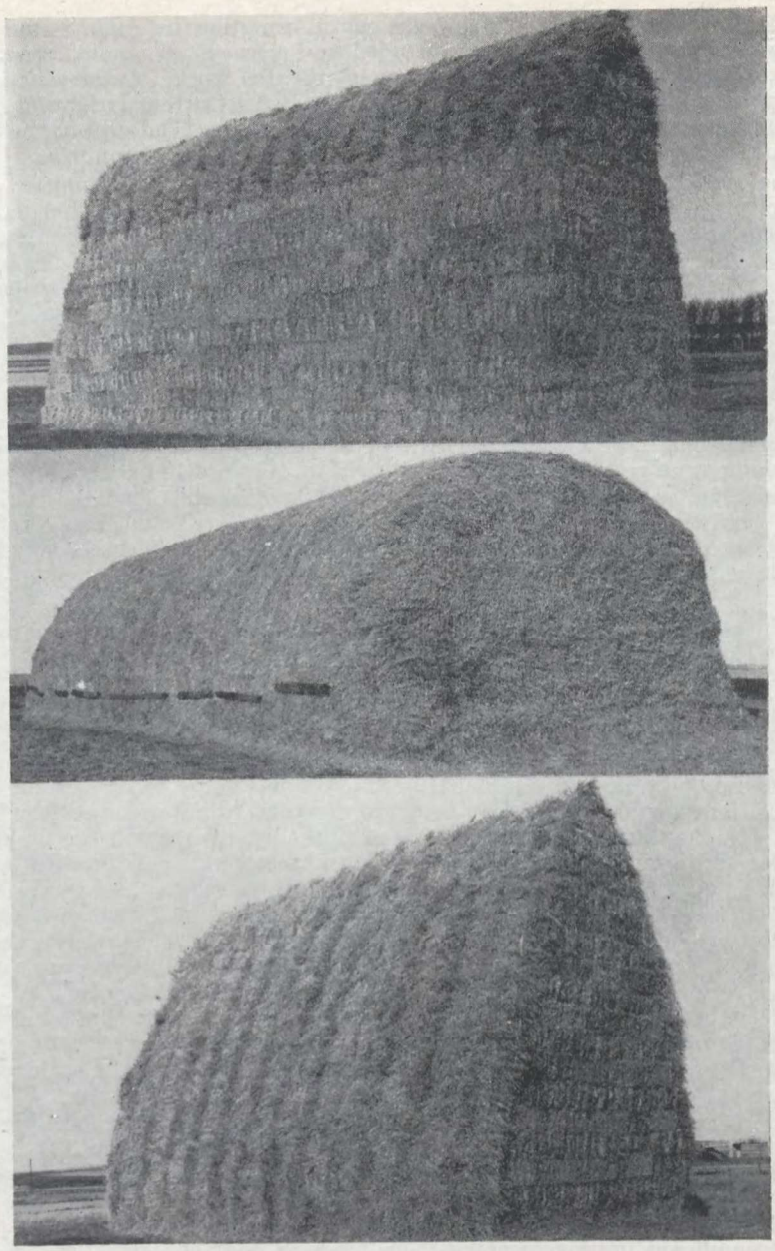


FIG. 29 (Top)—Baled oat straw with loose straw on top only—20 tons.

FIG. 30 (Middle)—Loose wheat straw—20 tons.

FIG. 31. (Bottom)—Baled oat straw with loose straw on top and sides—20 tons.

of Agriculture believed there was sufficient information to guide sounder land use planning. Such information included soil survey, economic, ground and surface water, grass survey, and 27 years of research work. An area of 12 rural municipalities was selected, which embodied the Swift Current Irrigation Project. A Committee was appointed to make the land use study. The staff of the Station has undertaken special studies the past three years for the Committee.

The report has been completed by the Committee and submitted to the Saskatchewan Government for those municipal officers interested, and the Conservation and Improvement Committees printed copies of the report, which are available by applying to the Saskatchewan Department of Agriculture, Regina. This report fills a need in Saskatchewan to guide any program of better land use.

Beef Cattle Study

The National Beef Committee decided to undertake special studies to learn the practicability of selling cattle by carcass grade and weight. Through a Sub-Committee, the Station initiated and undertook all the experimental work. The studies were conducted at Vancouver, B.C., because the B.C. Beef Grading Act had been in operation for some years. Over 3,500 head of cattle were studied individually. Much information was obtained, and those interested can obtain a copy of the report from the Information Service, Department of Agriculture, Ottawa.

ANIMAL HUSBANDRY

Range Sheep Improvement

RAMBOUILLET BREEDING

The major part of the Animal Husbandry work at the Swift Current Station has consisted of a sheep breeding program designed to improve the Rambouillet breed. Rambouillet sheep have been, and probably always will be, the basis of the range sheep industry in southwestern Saskatchewan. This breed of sheep is adaptable (rugged), able to withstand climatic extremes, has good foraging ability (rustlers), and has the gregarious or herding instinct. All of these characteristics are desirable from the standpoint of range sheep. However, the early Rambouillet sheep had a short, greasy fleece of fine wool, with a tendency towards excessive wrinkling and wool blindness. These Rambouillets also had a poor mutton conformation, being leggy, narrow, long in the neck and slack in the quarters. Breeding work at Swift Current has been directed towards the improvement of these undesirable wool and mutton qualities, and has met with considerable success.

A program of selective breeding, coupled with inbreeding, has produced encouraging results since this breeding project was commenced in 1941. Registered Rambouillet ewes, obtained from a division of the Dominion Government flock at the University of Saskatchewan, have been mated to improved rams secured from the better Rambouillet flocks in Canada and the United States. A most significant improvement has been made in body conformation, in eliminating wrinkles and excessive face cover, and in quality of fleece. The 1947 Rambouillet has a smooth body with very little tendency towards a wrinkle or skin fold on the brisket. Shorter, better-filled legs, combined with a deeper body, have produced a more desirable mutton carcass. A longer stapled, lighter shrinking fleece of more uniform quality has also resulted from this breeding policy. In spite of these improvements, much yet remains to be done in improving the Rambouillet breed. There is room for more improvement in body conformation and in the elimination of excess wool on the face.

Since the inception of this Rambouillet breeding project, an average of 25 rams has been distributed each year to the sheep ranchers of southwestern Saskatchewan. The calibre of these rams has been such that they have produced a noticeable improvement in the flocks where they have been used. At no time in the history of the sheep industry in Western Canada have better Rambouillet rams been available.

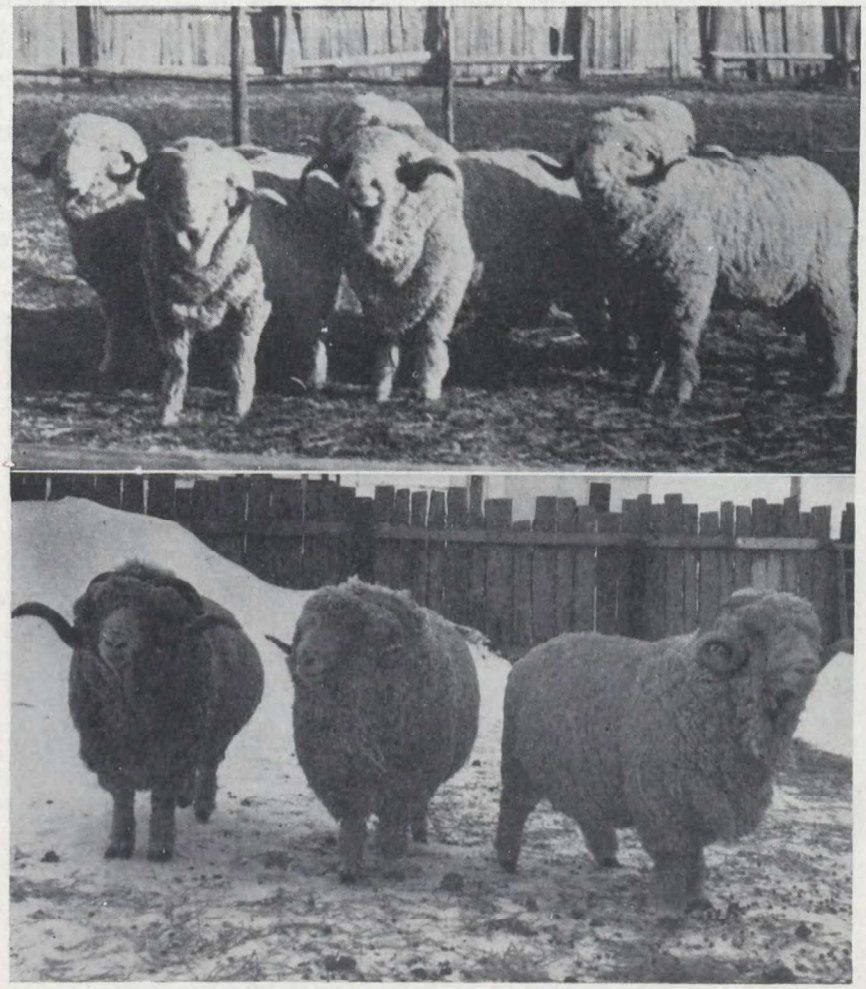


FIG. 32.—(Upper) Rambouillet rams used in 1941. Note wrinkles, face cover, and tendency towards legginess.

FIG. 33.—(Lower) Rambouillet rams used in 1947. Note improved conformation, smoothness and depth of body.

ROMELDALE BREEDING

In 1944, a small flock of purebred Romeldale ewes and rams were imported from California and located at the Swift Current Station to establish their usefulness under Canadian conditions. This breed of sheep has been developed by

A. T. Spencer of Winters, California, during the past 30 years. They are the result of an original cross of New Zealand Romney rams on Rambouillet ewes followed by an intensive inbreeding policy to establish type. These white-faced sheep have a long-stapled, light-shrinking fleece that grades three-eighths to half blood. They are comparatively open in the face, and they possess a much better mutton conformation than the pure Rambouillet breed.

This Romeldale flock is being maintained as a pure breed and is handled under the same conditions as the Rambouillet flock. Results to date indicate that the Romeldale is adaptable to local climatic conditions. They are a hardy breed, with foraging ability comparable with that of the Rambouillets. Romeldale ewes are quiet to handle, and they make excellent mothers. The wool they have produced under Canadian conditions is of exceedingly good quality and has received favourable comment in this regard from representatives of the wool trade.

In order to evaluate the usefulness of the Romeldale, several rams have been located with selected ranchers and farmers. It is anticipated that they will make a worthwhile improvement on short stapled range flocks, as well as on farm flocks of indifferent breeding.

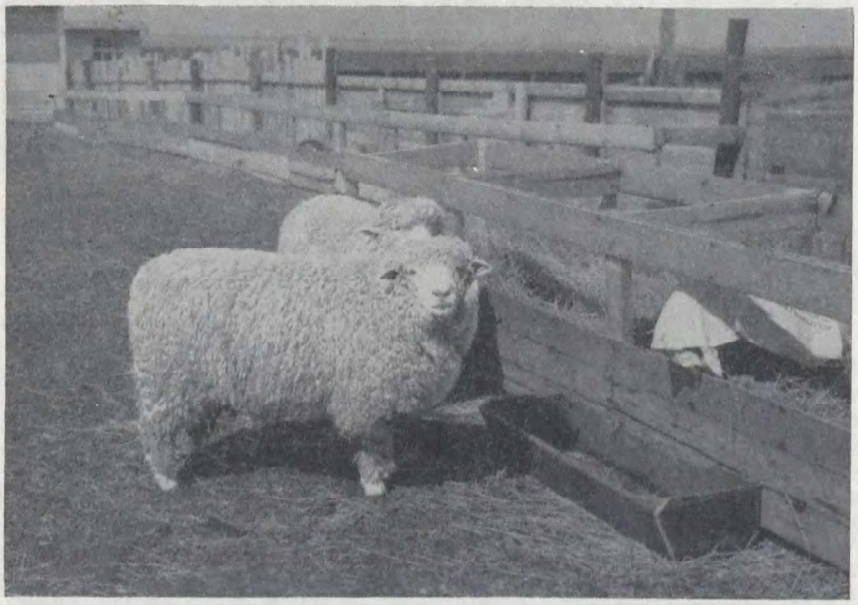


FIG. 34.—Yearling Romeldale rams. Note clean face, smooth deep body with long stapled growth of wool.

IRRIGATED PASTURES FOR FINISHING LAMBS

A series of lamb feeding experiments have been conducted at Swift Current to establish the practicability of reducing feed costs by fattening range lambs on irrigated pastures of various types. Annual irrigated pastures of kale, peas, turnips, corn, rape, and rape-oats mixture have been tried out along with a perennial irrigated pasture of mixed grasses. Range lambs weaned in August were allowed to run on these various pastures from weaning time until late fall when weather conditions prevented further grazing. Similar groups of lambs were fed a standard feed-lot ration in a dry lot in order to compare daily gains.

Preliminary results are in favour of the annual irrigated pasture of rape and oats mixed. Good stands of this type of pasture have been obtained by seeding 1 bushel of oats with 3 pounds of rape per acre. While daily gains on this pasture were lower than feed-lot gains, the cost of such gains was less than two-thirds that of feed-lot gains. This pasture mixture produced a net return of $31.29 per acre when used for lamb finishing as compared with $21.13 per acre from similar irrigated land used for the production of alfalfa hay.

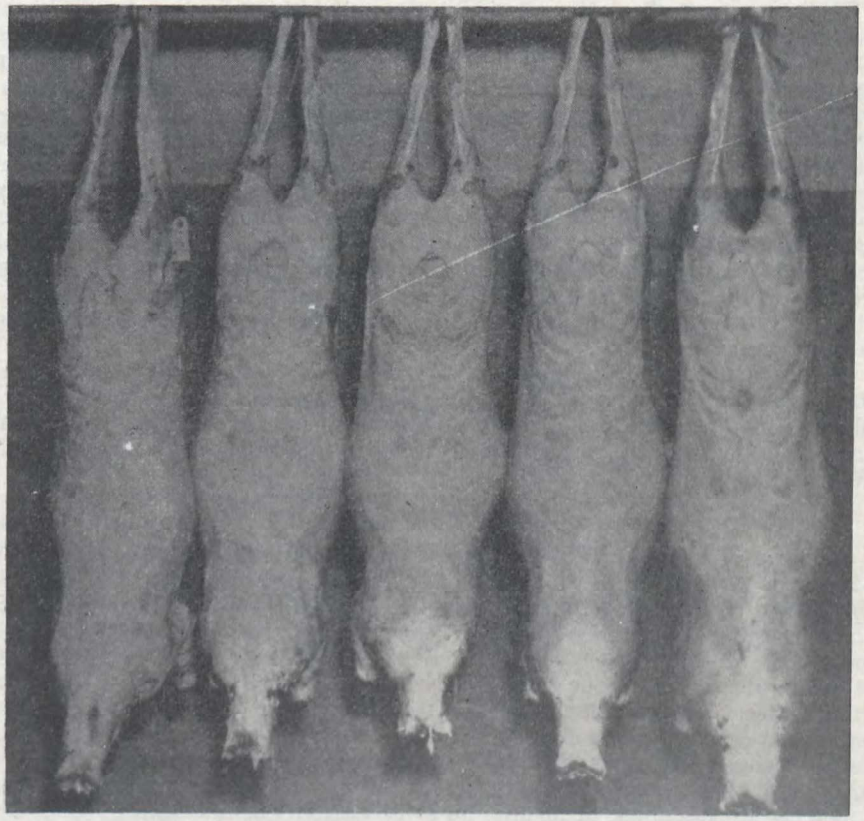


FIG. 35.—Grade A lamb carcasses. Left to right: Romeldale, Romnelet, Southdown × Romnelet, Rambouillet, and Romeldale × Rambouillet.

The carcass quality of the lambs fattened on the irrigated pasture was fully equal to that of feed-lot lambs. Results to date indicate the necessity of a short period of dry lot feeding after the close of the pasture season in order to secure the proper degree of finish. Experience in conducting these experiments points to the fact that it is advisable to wean lambs and get them on good irrigated pasture as early as possible in the summer. If early lambs can be put on irrigated pasture as soon as the native range is dried up, a maximum use of pasture and a minimum grain feeding period is assured. Any feed shortage throughout the life of a lamb will result in proper finish only being obtained at heavier weights which may bring a discount, hence the need for plenty of good feed at all times.

Finishing Different Breeds of Lambs

Experiments have been conducted for the purpose of evaluating rates of gain, feeding efficiency and carcass quality of various breeds of lambs. Rambouillet, Romeldale and Romeldale-Rambouillet crossbred lambs raised at the Swift Current Station have been fed along with Romnelet and Southdown-Romnelet crossbred lambs produced at the Dominion Range Experiment Station, Manyberries, Alta.

Preliminary results, after conducting some of these feeding tests for three years, indicate little significant difference in the rates of gain of the various groups of lambs. The crossbred lambs were the most efficient from the standpoint of economy of gains. The carcasses of all lambs were followed through at the packing plants in order to study the variation in type and quality. The most desirable carcasses were produced by the Southdown-Romnelet crossbreds, these being of a type and quality that brought special commendation from representatives of the meat trade. In order of merit, this group of carcasses was followed by those of the Romnelet, Romeldale, Romeldale-Rambouillet and Rambouillet. There was a tendency for the lambs with the largest concentration of Rambouillet blood to be overweight when they reached the proper stage of finish. Results indicated that this drawback could be largely overcome if the lambs were put on feed as early as possible in the fall and provided with a ration that would permit maximum gains.

These lamb finishing experiments indicate the practicability of breeding mutton-type rams to white-faced ewes for the production of better quality market lambs on both farm and ranch. Such a policy also assures the operator of greater returns from the wool clip, especially if the white-faced ewes are of the Romeldale or Romnelet type.

Swine Breeding

Early in World War II, when Canadian swine production was being rapidly expanded, a herd of improved-type Yorkshire hogs was established at the Swift Current Station for the purpose of making available to local farmers the best type of breeding stock. Top quality Yorkshire hogs have been distributed at an average rate of 40 head per year since this herd was introduced, with the result that swine production in the Swift Current district has been greatly stimulated. Formerly there were practically no breeders of registered Yorkshires in the area, whereas now a considerable number of farmers are making a business of producing registered hogs. This has resulted in a measurable improvement in both the quality and quantity of hogs produced locally, with every indication of more permanence to this phase of farming in southwestern Saskatchewan.

Advanced Registry testing has been carried out consistently, with the result that the majority of the breeding stock now being carried in this herd has been qualified.

Experiments have been conducted to determine the value of immature oat hay and alfalfa meal as supplements to provide vitamins "A" and "D" in the ration for pigs. These tests indicate that the addition of 5 per cent immature oat hay to the ration will produce results, equal to a similar ration that included alfalfa meal as the supplement. Such green supplements will replace fish oil in the growing and finishing rations for hogs, and they have the added advantage of availibility on every farm from home-grown feeds.

Supplemental Feeding on Grass

Experimental work has demonstrated that cattle over one year in age will make daily gains of over two pounds when on good, green pasture during the period May, June, and July. However, as the grass matures and cures, its

nutritive value as well as its palatability decreases, and there is a corresponding decrease in daily gains until the animals are only maintaining their weight in October.

Results of experiments at Swift Current are in agreement with findings elsewhere concerning the value of supplementing the mature grass with grain or concentrate feeds during the late summer and fall months. Such supplements fed on grass enable high daily gains to be maintained until late fall, and result in finished cattle by the time winter sets in, rather than feeder cattle that are not in fit condition to go to the packing plants. This type of feeding makes greater use of grass in the finishing process, and reduces the amount of grain and concentrates required as compared to feed-lot finishing.

A daily ration of 8 to 10 pounds of oats and barley, or 2 to 3 pounds of linseed oilcake will produce daily gains of 2 pounds per day when fed to yearling steers on good grass during the late summer and fall months. This practice enables finished cattle to be marketed in November and December when the market is glutted with feeder cattle. Less labour is required for such feeding and cattle tend to be cleaner and healthier than when fed in feed-lots. This type of feeding also eliminates the danger of a setback that often occurs when cattle are abruptly changed to feed-lot surroundings. In short, supplementary feeding on grass means more economical finishing as it makes maximum use of pasture with a minimum requirement of grain or concentrates.

POULTRY

The raising of poultry in southwestern Saskatchewan has been practised largely as a sideline to general farm operations. Events during the war years, however, demonstrated that under certain conditions poultry raising could very well become an important part of the farm program.

The Poultry Department of this Station has continued to be keenly interested in the problems of the practical farm poultry keepers. Experimental and demonstrational work along many lines have been undertaken in an effort to solve the many problems which present themselves.

Chickens

BROODING AND REARING

The essential equipment for proper brooding of chicks and turkey poults consists of an insulated brooder house, a reliable brooder which may be coal, oil or wood burning, and a sufficient number of feeders and waterers so that the young birds are not required to compete for feed or water. A very common size for the brooder house is 10 feet by 12 feet. There is a trend, however, to a somewhat larger house which permits the birds to get farther from the source of heat and to find the temperature which suits them best. It has been demonstrated that chicks will grow and feather better if the brooding temperature is lowered by five degrees per week.

The practice of placing large amounts of glass in the southern exposure of a brooder house makes it difficult to control temperatures during sunny days in late spring and early summer. It is suggested that one of the windows be placed in the east and one in the north side of the brooder house to help overcome this problem.

A reliable chick starter or poult starter mash should be purchased and placed in small chick-sized feeders before them at all times. Bulletins are available from this Station on the construction of brooder houses and the care and management of baby chicks.

Experience has indicated that the chick starter mash should be fed for the first five weeks. Thereafter, the birds should be changed to a growing mash and cracked or whole grain. The growing mash is most satisfactorily compounded by mixing a commercial growing mash concentrate with mixed, home-grown ground grains. Fresh succulent young green feed and milk are the two best feeds for growing poultry. By moving the brooder house to fresh young green feed regularly, a good supply of green food will be available while the birds are young.

SELECTING THE LAYERS

The birds which are selected to go into the laying pen must be well grown, possess ample vitality, as well as showing some of the characteristics of a good layer. The process of culling the flock, however, does not end with the selection of the pullets in the autumn. It is rather a continuous process which should be in progress throughout the entire laying year. Hens which have not developed as expected, those which show evidence of unthriftiness and those which have not come into production by mid-winter should be removed and marketed. They are a drag on the balance of the flock which may be in good production. Their removal provides more floor and hopper space for those which remain.

The practice of home mixing of the laying ration has almost disappeared. In place of this we find a protein, vitamin, and mineral supplement which can be purchased and mixed with home-grown ground grains to form the laying mash. Extra milk and extra fish oil can be fed with these laying mashes and will usually improve them. The laying mash should be available in open hoppers at all times. Whole grain can be fed night and morning. Young hens in the early winter should receive the heaviest feedings of whole grain, but this should be gradually reduced until only enough is being fed to keep the birds in a good condition of fleshing. Over-feeding of whole grain tends to result in over-fat birds.

POULTRY HOUSING

Considerable attention has been given in recent years to the problems of poultry housing and ventilation by the Poultry Department of this Station.

It has been demonstrated that many of the problems of prairie poultry housing can be overcome if attention is paid to the following points:

(1) A minimum depth from front to back of 20 feet. More recent observations would indicate that 28 to 30 feet will give even better results.
(2) Thorough insulation of walls and ceiling.
(3) A solid ceiling is essential where a controlled system of ventilation is used.
(4) Provision for under-floor insulation and drainage.
(5) Storm sashes should be provided for all fixed windows.

The Ventilation System.—A number of types of ventilation systems have been tested. The one which provided the most satisfactory conditions, in the tests at Swift Current, was the single outlet flue system. Essentially this consists of a single outlet flue which runs from floor level to a point two feet above the highest point of the building.

Fresh air is admitted through tilt-up top tier windows and through a ceiling intake which drains air from the loft.

The following points are important in the installation and operation of the flue system of ventilation:

1. Minimum size of flue, no matter how small the house is, 15 by 15 inches inside measure. Pens with more than 500 square feet require larger flues.

2. Outlet flue must be insulated from ceiling height to its very top. Uninsulated flues will not "draw" properly and will frost up in cold weather.

3. The flue should be as far as possible from the source of intake to provide for recirculation of the air.

4. The flue should be wholly within the pen, but will operate as satisfactorily when placed against an end wall as when placed in the centre of the pen.

5. In houses with more than one pen, each must be ventilated by a separate outlet flue.

6. The ventilator head should be open. The corner posts of the flue should be extended upwards at least 8 inches and a large, flat ceiling placed above them. Louvres must never be placed in the ventilator head openings.

Tests have shown that the loft of the ordinary laying house can be used as a source of fresh air during the winter months. The "suction" of the outlet flue will draw air from the loft through a 24 by 24-inch opening cut in the ceiling of the pen. No openings are cut which lead from the loft to the outside. Air drawn out of the loft is replaced by infiltration, and consequently this forms a source of intake which is unaffected by sudden winds.

Equipment.—Plans for the construction of various types of indoor laying mash hoppers are available free of charge. Figure 36 gives the details for the construction of one which has proved very satisfactory at this Station.

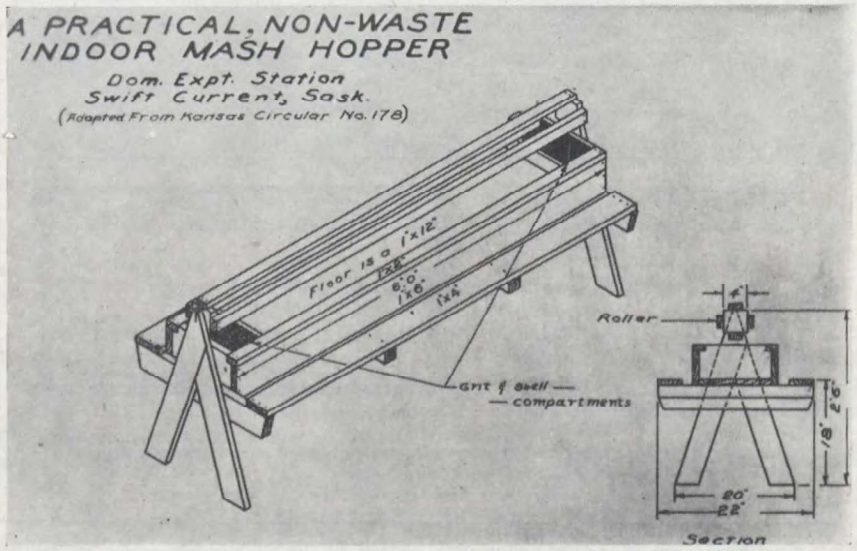
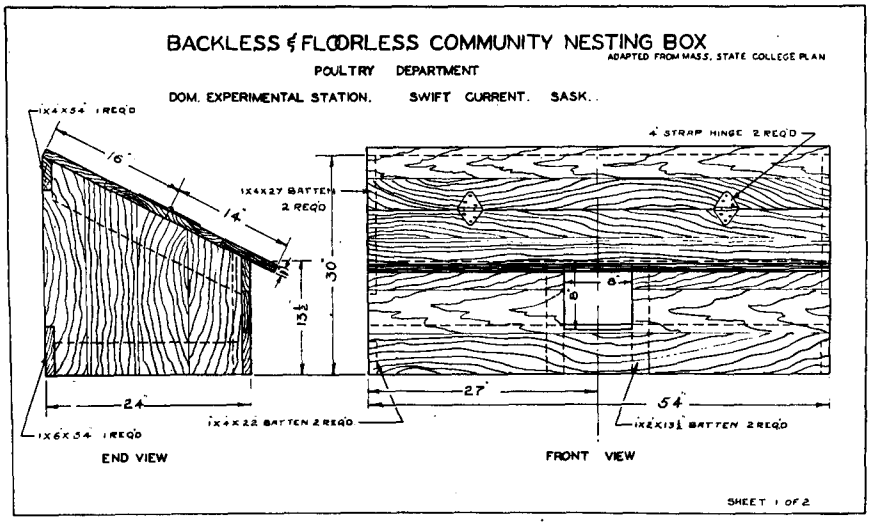


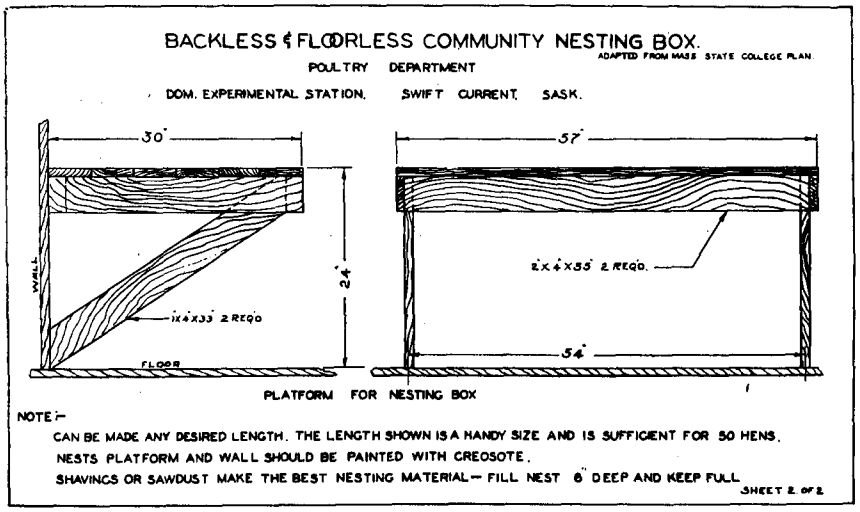
FIG. 36.—Construction details for a practical non-waste laying mash hopper.

A recent development in laying house nests has been the "community nest". These differ from the common nests in that there are no single divisions. Each nest is usually 24 inches wide and from 5 to 10 feet long with but one or, at the most, two openings. As many as 15 hens can use it at one time.

Figures 37, 38 and 39 show the details of a type of community nest in use at Swift Current. These have proved very satisfactory. The important points in their operation are as follows:

(1) The deep nesting compartment must be kept well filled with shavings, sawdust or cut straw. Long straw is not satisfactory.
(2) Eggs must still be collected regularly.
(3) The nests can be further darkened by hanging a piece of sacking part way down the opening.





FIGS. 37 (Upper) and 38 (Lower) show construction details for the community nesting box.

A piece of modern poultry house equipment, which will soon pay for itself in increased production, is a laying house water fount which is equipped with a small oil burning lamp to keep the water from freezing during cold weather. These can be purchased through poultry supply houses.

TURKEYS

A study of the problems of breeding, feeding, and management of turkeys has become an important part of the work of the Poultry Department of this Station. Facilities for this work have been greatly enlarged and research work along a number of lines is in progress.

Rapid changes have taken place in the turkey industry on the prairies in recent years. The development of a commercial turkey hatching industry has

made available day-old poults over a period from March to June. It is no longer necessary for the farmer turkey grower to maintain a breeding flock over winter. On the other hand, it opens wide possibilties for the development of large flocks of turkey hens for the production of hatching eggs for the commercial incubators. Flocks maintained for this purpose must be approved under the Provincial Turkey Approval Policy. Application should be made to the Poultry Commissioner not later than August 15.

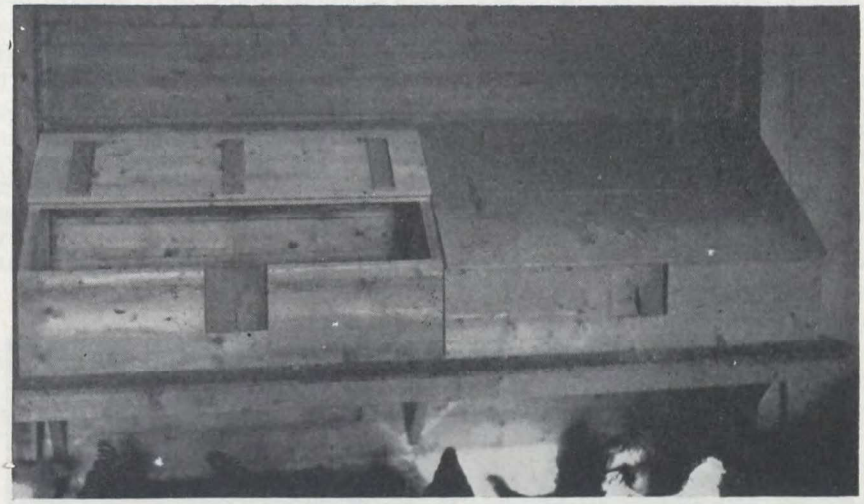


FIG. 39.—This photo shows the community nesting boxes in place in the laying pen. The lid of one section is open to show the ease with which eggs may be collected.

THE SELECTION AND CARE OF TURKEY BREEDERS

Consumer demand for a blocky, thick-breasted, meat-type turkey makes this one of the most important points in the selection of breeders. Care should be exercised, however, to see that breast thickness is not over-emphasized to the extent that the birds become unbalanced with poor reproductive ability. Good length of keel and back and breast thickness carried well back to the end of the keel are essential in good breeding stock. Flocks maintained for egg production should be allowed at least 10 square feet of clear floor space per bird.

A breeder mash is necessary for a period of six weeks before egg laying commences and should be fed throughout the laying season.

Well matured breeders can be brought into production within three to five weeks by the use of artificial lights during the late winter. Any white light is satisfactory. Toms require to be placed under lights approximately two weeks in advance of the hens.

Special turkey egg fillers are available for the standard egg case which will hold 200 eggs. This is the most satisfactory method of shipping turkey hatching eggs.

ARTIFICIAL BROODING OF TURKEY POULTS

The basic principles of the brooding of turkey poults are similar to those of chick brooding. Poults require more care and attention during the first few days to see that they get started to eat, and that they do not acquire the habit of piling up at night. Whole flake rolled oats, scattered over the feed at two-hour intervals for the first few days, will attract their attention to the feed. Coloured

marbles in the feed will also serve the same purpose. A weak light left in the brooder house over night will aid greatly in getting them to settle down for the night.

A reliable poult starter mash is strongly recommended as the most satisfactory feed for starting poults. Experimental work done at this Station has demonstrated that the cereal grains used in poult starter mashes should be coarsely ground. Most of the difficulty experienced with pressure necrosis or "caking up of the beak" of turkey poults has been shown to be caused by the starter mash being too finely ground.

Milk and succulent young green feed are two of the best feeds for growing turkeys. They should be supplied in abundance after the poults are well started.

SUMMER FEEDING OF TURKEYS

The poults should be changed to a growing mash after the seventh week. This is best made by adding a commercial growing mash concentrate to home-grown ground grains. The growing mash should be available in range-type hoppers throughout the summer months. Figure 40 shows a simple type of range feeder.

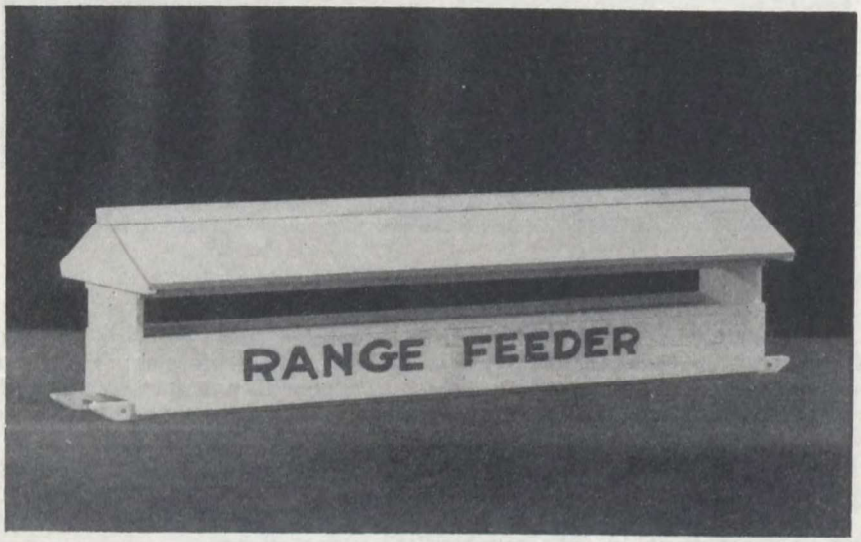


FIG. 40.—An easily constructed range feeder for growing turkeys.

Whole, plump oats are an excellent feed for growing turkeys. They can be induced to eat them freely if they are added, in progressively larger amounts, to the growing mash from the time the birds are seven weeks old.

SANITATION AND DISEASE CONTROL

The frequent moving of feeding and watering equipment and shelters to clean grassland is an important step in disease prevention for both chickens and turkeys. Clean rangeland is land over which neither chickens nor turkeys have ranged for a period of two years.

The use of sodium sulphamethazine as a preventive and control for coccidiosis of chicks is recommended. Manufacturers' directions should be followed in its application.

HORTICULTURE

The value of horiticulture to the prairie farm cannot always be appraised from an economic basis. Well grown fresh and storage vegetables fill a definite need in the diet of the family. The growing of shelterbelts contributes towards more comfortable living on exposed farmsteads and the growing of ornamental trees, shrubs, and flowers serves to provide beauty and relaxation. An interest in horticulture can add greatly to building up pride in the home surroundings and will contribute towards the development of a more permanent agriculture.

Insufficient moisture is usually the limiting factor in horticultural development, and for this reason every effort should be made to conserve and make as much use as possible of the available supply. Small dams, dugouts and dykes have been used successfully to hold back run-off water for later use. The recommended gardening practices, which are given below, are based on data from tests and observations made at this Station during the past 10 years.

Shelterbelt Planting

Experience over a period of 40 years has demonstrated that farm shelterbelts can be grown successfully, and that they will not only provide summer and winter protection, but will greatly enhance the value of the farm. Many of the hazards of growing fruits, vegetables and ornamentals will be removed when protection is provided.

The following points should be used as a guide in planning the shelterbelt:

1. The location should be well chosen to take advantage of natural features where use of run-off water may be made.

2. The area to be planted should be well fallowed for at least one year.

3. The area set aside for trees should be of sufficient size to provide for a permanent fallow strip, at least one rod wide, on *each* side of the belt. This is necessary to provide a permanent fallowed area from which the tree roots can draw moisture.

4. The area enclosed by the shelterbelt should be large enough to provide sufficient land for the planting of ornamentals and vegetables without the need for crowding them too close to the roots of the windbreak trees. Ornamentals and vegetables cannot compete with older trees for the available moisture under dryland conditions.

5. The number of temporary type trees should be reduced to 10 to 15 per cent of the belt except in areas with a high water table, or those favoured by abundant moisture through irrigation or spring run-off.

6. The standard prairie shelterbelt consists of five rows with the trees spaced 4 to 6 feet apart each way.

7. The farmstead should be enclosed on at least the north, west, and south sides.

8. The belt should be protected against drifting soil and snow by the planting of a single row of caragana about 100 feet outside the belt.

RECOMMENDED VARIETIES

Permanent—Green ash, American elm, white spruce, Colorado spruce, caragana.

Temporary—Poplar, willow, cottonwood, box elder.

Care of Established Tree Belts

Established tree belts can often be rejuvenated by providing permanent fallow strips on each side. In the case of the wide belts, it is often possible to remove one or more centre rows to provide additional fallowed strips. A portion of the road allowance area has often been used for this purpose when the belt was planted against a line fence. Trees for windbreak planting are obtainable from the Dominion Forest Nursery Station, Indian Head, Sask.

Fig. 41.—Spruce make an ideal permanent shelterbelt.

The Vegetable Garden

Tests have shown that the vegetable garden should be placed on fallowed land each year. This will necessitate a garden area twice the size of that required for one season's garden. The summerfallow year provides a good opportunity to add a dressing of well rotted manure. Under dryland conditions the rows should be spaced at least 30 inches apart. Spring work should be reduced to a minimum, and should be done just prior to seeding to avoid loss of soil moisture.

SEEDING

A succession of crops and ease of maintenance should be considered when the garden is planned. Perennial vegetables such as asparagus and rhubarb can be placed in rows down the middle of the gardens or at one end. Seeding of such vegetables as onions, carrots, parsnips, peas, lettuce, etc., is best done soon after May 1. Corn, beans and vine crops are best delayed until after May 15 or later, depending on the season. The setting out of well hardened cabbage and cauliflower plants can be done after May 15, but tomatoes, egg plants and peppers are best delayed until after June 1.

Extreme care must be exercised to see that all seeds are covered with moist soil. In well protected, level areas deep furrows can be opened and the seed sown in them—each kind being covered to the required depth. These deep furrows provide protection from hot winds and sun. Newly set out plants must be well shaded. Tomato tins and other commercial vegetable tins, with both bottom and top removed, are excellent for this purpose.

KINDS AND VARIETIES OF VEGETABLES

Asparagus—This vegetable should be found in every farm garden. It is the first available green in the spring. Asparagus should be planted where it will receive run-off water. It can be started from seed, but two-year-old plants are better. The variety Mary Washington is recommended.

Beans—With few exceptions, beans can be expected to produce a crop. Varieties recommended are:

Green—Stringless green pod; Masterpiece
Wax—Round pod kidney wax

Beets—Make two sowings 10 days apart. Harvest when approaching two inches in diameter and process the surplus for winter use. Large storage roots lack quality. Stokes Special Early and Detroit Dark Red are recommended.

Celery—This crop requires an abundance of moisture. Non-blanching types have replaced older blanching types. Start indoors and plant out soon after mid-May. Utah (Salt Lake) is the variety recommended.

Cabbage—For best results, all cabbage should be started indoors. During favourable years, or under irrigation, however, it is possible to get good results from late varieties sown out-of-doors.

Early—Jersey Wakefield; Golden Acre
Mid-Season—Glory of Enkhuizen
Late—Penn. State Ballhead; Danish Ballhead.

Cauliflower—Plants should be started indoors and set out about May 15. Curds are blanched by tying the leaves together at the top. Early Snowball is the best general purpose variety.

Carrots—This vegetable must be thinned early for best results. Recommended varieties are Nantes and Chantenay.

Sweet Corn—Hybrid varieties are replacing many of the standard varieties. They produce higher yields and larger cobs. Quality is not quite up to the best standard varieties. Only a very few hybrids are early enough for our conditions. Do not save seed from hybrid varieties. Standard varieties recommended are:

Early—Golden Gem
Mid-Season—Dorinny
Late—Golden Bantam

Hybrid varieties:

Spancross 13·3; Marcross 13·6; Seneca Dawn.

Lettuce—Grand Rapids is the leading variety of leaf lettuce. For best results with head lettuce, the seed should be sown indoors in early April, and the plants set out in early May. Space plants 10 inches apart. The variety New York is recommended for this purpose.

Onions—Outdoor-sown onions have not always proved successful. Where seeding outdoors is practised, seed should be sown as early as possible and the seedlings thinned very early in the season. Transplanted onions, grown as for head lettuce, are much more successful. Plant six inches apart.

Varieties:

For the open ground—Mountain Danvers
Sets—White and Yellow Dutch Sets
Transplants—Giant Yellow Prizetaker.

Parsnips—Sow seed as early as possible in spring. Very late fall seeding has often produced better yields. Short Thick is recommended for ease of harvesting.

Peas—Peas are best not sown in cold, wet soil. The variety Alaska is early but lacks quality. Lincoln (Homesteader) is recommended for the main crop. Successive sowings should be made.

Radish—Saxa and French Breakfast are the most popular globe types, and White Icicle the most popular long type tested at Swift Current.

Rhubarb—This vegetable should be located where it will receive run-off water, if possible. A portion of the bed should be renewed annually. Only small one-eyed divisions should be planted on fallowed land. Deep and thorough cultivation, with a liberal application of well-rotted manure, should be the rule before planting. Macdonald is the leading variety, but Sutton has proved to be very early and vigorous under southwestern conditions. It is not quite equal to Macdonald for quality.

Spinach—This vegetable tends to bolt to seed rapidly in hot weather. An excellent supply of this valuable green can be grown early in the season, if a glass covered frame is set up in a sheltered location facing south. A rich soil should be used, but the surface of the soil in the frame should not be above ground level. The variety Bloomsdale is recommended. New Zealand Spinach can be grown for a late summer green.

Swiss Chard—A valuable early summer green. Sow as for beets, and thin to stand 6 or 8 inches apart. Lucullus is the most popular variety.

Tomatoes—The determinate or "Self-Pruning" varieties are recommended for general use. They can be staked, but no pruning is necessary.

Varieties:

Pruning—Harkness; Best of All
Non-Pruning—Early Chatham; Bounty.

Where artificial watering can be practised, Redskin should be added to this latter list.

Turnips (Swede, Rutabaga)—The newer variety, Laurentian, is far superior in uniformity, quality and yield to the older varieties. Seeding of this vegetable should be delayed until close to the end of May.

Vine Crops—These vegetables do best on lighter loam soils which warm up early in the season.

Squash—Buttercup; Hubbard
Pumpkin—Sugar
Vegetable Marrow—Long White Bush
Watermelon—Early Canada; Sensation; Honey Cream
Muskmelon—Farnorth
Cucumber—Early Russian; Delcrow; Improved Long Green; Fortune.

Potatoes—Plant on fallowed land not later than May 12. The need for constant attention to the quality of seed potatoes cannot be over-emphasized. Annual seed plot grown from Certified or Foundation seed is recommended.

Varieties:

White—Irish Cobbler; Gold Nugget
Pink—Warba; Early Ohio
Irrigation only—Netted Gem; Columbia Russet.

Registered seed of many of the vegetable varieties listed is now available and is recommended in preference to commercial strains.

IRRIGATING THE FARM GARDEN

Irrigation water is often available from small dams, dugouts or irrigation canals. Where it is available, the following points should be noted:

(1) The frequent summerfallowing of vegetable gardens will not be necessary.

(2) Spacings between rows can be greatly reduced.

(3) Root vegetables such as carrots and beets need not be thinned so rigidly. They tend to become too large and coarse where this is done.

(4) Fall cultivation and irrigation of the garden area is strongly recommended.

(5) If surplus water is available in the fall, it should be used on trees, shrubs and fruit trees prior to freeze-up.

FIG. 42.—Spreading spring run-off water on the vegetable garden area.

ORNAMENTAL GARDENING

TREES AND SHRUBS

Within the shelter of the windbreak, trees and shrubs have become an important part of the grounds of the Experimental Station at Swift Current. If care is exercised in the choice of well-adapted varieties and attention is given to a few important rules in care and management, ornamental shrubbery can be grown successfully.

Spring planting on fallowed land is recommended. Wide spacing of the young bushes is advisable to allow for proper development and to avoid future competition for moisture. Specimen trees are benefited by having a saucer-shaped circle of fallow maintained about them to aid in holding rain water.

The following is a brief list of trees and shrubs which have proved adaptable for ornamental planting:

Trees—Green ash, American elm, white spruce and Colorado spruce.

Shrubs—Siberian crab, Aldenham flowering crab, Russian olive, common caragana, European bird cherry, Amur maple, common honeysuckle, Russian sandthorn, native hawthorne, common lilac, villosa lilac, high bush cranberry, cotoneaster, Persian yellow rose, Betty Bland rose, spiraea media, Siberian almond, dwarf burning bush.

These shrubs are listed in order of their height at maturity.

FLOWER GROWING

The growing of flowers in southwestern Saskatchewan will, in most years, repay the efforts of the gardener who is seeking to improve the home surroundings. Flowers will show a greater response to additional moisture than most horticultural crops, and this factor should be given careful attention when choosing a site for the flower garden.

ANNUAL FLOWERS

Annuals are divided into two main groups, those that can be successfully sown out-of-doors, i.e., hardy annuals, and those which require to be started indoors or in a hotbed, i.e., half-hardy annuals. The following is a list from each group which have proved most successful under dryland conditions:

Hardy Annuals—Linaria, California Poppy, Mignonette, Tagates, Nasturtium, Godetia, Bartonia, African Daisy, Calendula, Cornflower, Clarkia, Sweet Peas, Larkspur.

Half-Hardy Annuals—Petunia, Alyssum, Lobelia, Verbena, Pansy, Snapdragon, Stocks, Dianthus (Pinks), Aster, Gaillardia (double and single), Salpiglosis, Ageratum.

PERENNIAL FLOWERS

Perennials, besides including some of the most popular flowers, are valuable because of their permanency. Experience has shown that, if given reasonably good conditions and ordinary care, there are many worthwhile perennials which can be grown successfully in this area.

Spring and early summer bloom can usually be counted on but, without artificial watering, late summer bloom is often meagre. A number of native plants are worthy of a place in the flower border.

One of the greatest drawbacks to the successful growing of perennials is the alternate freezing and thawing to which they are subjected during the early spring months. To overcome this, it is suggested that the flower border be placed where it will receive a good blanket of snow. A few boughs will often prevent this snow blanket from melting too soon in the spring. An eastern exposure is preferred for best results.

The following is a list of the best of the hardy perennials which can be recommended for general planting: Iris pumila*, Iris arenaria*, Iris germanica, Siberian Flax, Sweet Rockets, Ixiolirion montanum, Columbine (Long Spurred Hybrids), Oriental Poppy, Cerastium* (Snow in Summer), Creeping Veronica, Grass Pinks*, Maiden's Pink*, Sedum* (in variety), Maltese Cross, Lily (in variety), Creeping Gypsophila*, Baby's Breath, Saponaria ocymoides*, Ox-eye

Daisy, Pentstemon glaber, Gaillardia, Peach-Leaved Bellflower, Carpathian Bellflower*, Clustered Bellflower, Oenothera macrocarpa*, Aethopappus pulcherrimus, Bachelor's Button, Chinese Delphinium, Tall Delphinium, Alyssum saxatile, Linum flavum* (Yellow Flax), Iceland Poppy, Peonies.

Those marked * are dwarf.

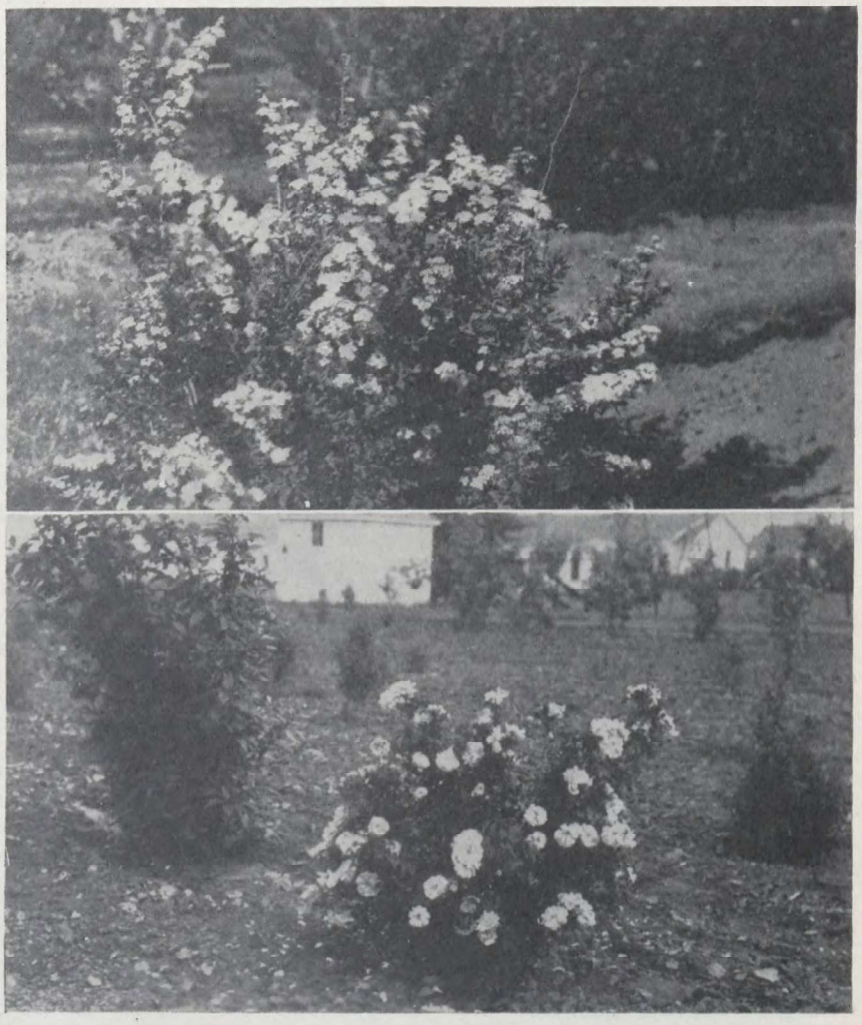


FIG. 43.—(Upper) *Spiraea media* has proven to be hardy and adaptable to prairie conditions

FIG. 44.—(Lower) Betty Bland Rose in bloom the third year after planting.

LAWNS

Farmstead lawns for which artificial watering is not available, should be established from the Fairway strain of crested wheat grass. This can often be done by drilling the seed into existing turf very early in the spring or just prior to freeze-up. Where it is necessary to level the area, it should be well prepared,

and the seed broadcast by hand in early spring or late fall. If fall seeding is practised, the area should be covered with boughs during the winter. In all cases, seeding should be heavy since crested wheat grass is not a creeping grass. Where the grain drill is used, seedings should be made in at least two directions, using every spout of the drill.

In specially favoured areas, or where a limited amount of artificial watering is possible, a small proportion of Kentucky blue grass should be added to the crested wheat grass. If abundant artificial watering is available, Kentucky blue grass is recommended.

Fruit Growing

Fruits for domestic purposes have been grown with moderate success in southwestern Saskatchewan. In common with all other horticultural crops, a suitable site, adequate protection and proper care are essential for success. A site with a northerly slope is strongly recommended to avoid sun-scald injury.

All fruit trees and bushes are most successfully planted in early spring. If they must be moved in the autumn, they should be heeled-in over winter and planted in the spring. One- or two-year-old bushes are much more easily established than those of a greater age. Trees of apple, crabapple and plum should be cut back to within a foot or 18 inches of the ground when planting is done. This encourages low branching, which is desirable. Subsequent pruning should consist of the removal of dead wood and only enough new growth to keep the tree in a symmetrical open form.

Currants and gooseberries are best cut back almost to ground level at planting time. Annual pruning thereafter consists of the removal of old wood as well as the weaker new growth. Cuts are made as near ground level as possible. All pruning is best done when the tree or bush is dormant.

VARIETIES

Apples—Heyer Seedling No. 12
For trial—Haralson, Blushed Calville and Oxbow

Crabapples—Osman, Dolgo, Florence, Rosilda, Trail, Rescue

Tree plums—Tecumseh, Pembina

Bush plums—Tom Thumb, Opata, Oka, Dura
For trial—M-118, M-122 and O-302

Black Currants—Kerry

Red Currants—London Market, Fay's Prolific

Raspberries—Chief, Ruddy
For trial—Trent, Madawaska

Gooseberries—Pixwell, Abundance
For trial—Gattenby

Rabbits are a great menace to fruit plantations. When present in small numbers, shooting, snaring, poisoning and a good dog are all of value in keeping them in check. A permanent rabbit fence is advisable but is an expensive undertaking. Extreme care should be exercised in using poisons.

Garden Insect Control

The introduction of newer insecticides in recent years has resulted in many changes in garden insect control measures. The most important new insecticide is D.D.T. It has many uses, but some care is required in its use. Only the wet-

table powder form should be used as a spray for plants. Oil-based barn and household sprays will kill plants. The wettable powder form is sold with a high concentration of D.D.T., usually 50 per cent, and must be diluted with the correct amount of water. The most common strength recommended is six level teaspoons per gallon of water. D.D.T. sprays should not be used on edible portions of plants during the last 3 to 4 weeks before harvesting. Many prepared dusts sold under trade names are ready for use and require no further dilution with carriers. If 50 per cent wettable D.D.T. is required for use as a dust, it must be mixed with an inert carrier such as flour.

FIG. 45.—(Upper) White spruce on Station grounds. Photo taken 1927.

FIG. 46—(Lower) The same block of spruce as shown in Fig. 45. Photo taken 1947. These spruce were grown without artificial watering.

A few common garden insects are mentioned below and control measures are given. Early application of control measures is essential.

Ants—Dust mounds or holes with 10 per cent D.D.T. dust made by mixing 1 pound of 50 per cent D.D.T. powder with 5 pounds of flour.

Aphids—Spray with 2 teaspoons nicotine sulphate per gallon of water. Spray should strike the insects, which are usually found on backs of leaves and tips of new growth.

Cabbage worm—Dust plants regularly with prepared derris dust. This is non-poisonous.

Currant worm—This insect strips the leaves of the currant and gooseberry plants. Spray or dust with 3 per cent D.D.T. or dust with derris. Use only derris dust after fruit appears.

Currant maggot—This insect is difficult to control. Spray heavily with 1 tablespoon of 50 per cent D.D.T. powder in 1 gallon of water just as the blossoms fade.

Potato beetle—Dust or spray with 3 per cent D.D.T. or spray with arsenical spray using 2½ tablespoons per gallon of water.

Tent caterpillar—Control same as potato beetle. Apply control on a warm day as soon as tents appear.

Grape leafhopper—This is an insect which infests Virginia creepers. Control measures as for potato beetle. Spraying most effective. Spray as soon as creepers leaf out and again in mid-July.

DISTRICT EXPERIMENT SUBSTATIONS

There are at present 13 experiment substations operating in the area served by the Swift Current Experimental Station. This area is large and embraces many districts where soil and climate have their own local characteristics.

It has been recognized for some time that these local characteristics have an important bearing on farming practices most suitable for individual areas. It is for this reason that, in selecting the location of the substations, an attempt was made to choose those areas which would best represent most of the conditions found in southwestern Saskatchewan. The areas selected and the operators at time of writing are as follows:

Bracken	J. Honey
Carmichael	A. C. Butler
Fox Valley	D. Mutschler
Gravelbourg	Pinsonneault Bros.
Kincaid	W. C. Phillips
Limerick	Smith Bros.
Pambrun	M. Colburn
Riverhurst	N. C. Rudd
Shackleton	C. D. Underwood
Shaunavon	H. Hockett
Tompkins	J. McEwan
Tugaske	R. Wilson
Valjean	F. Lindquist

These substations are privately owned, but are operated in close co-operation with the Swift Current Experimental Station. Although the contracts call for records to be kept on a maximum of one section of land, actually the operators keep a complete set of records on their entire farm setup. These records include acreage, yields, and all operations on individual fields, daily precipitation records, and a complete record of all business transactions on each of the various farm enterprises.

In addition to serving their own local areas, the substations provide an opportunity of testing such factors as cultural practices, cereal varieties, and forage crops under a wide range of soil and climatic conditions. This makes it possible to obtain considerable information on a problem under a variety of conditions within a short period of time. Results of work during the past 10 years are already proving of great value, particularly in making recommendations regarding cultural practices and assessing the relative suitability of new varieties of grain. Since certain field experiments are closely co-ordinated with the field husbandry work at the Swift Current Experimental Station, some results are presented under the section on Field Husbandry. Additional projects which are not carried on the Experimental Station are reported herein.

The following brief summary will give some indication of the conditions at each Station, the type of farming being carried on, and some of the progress that has been made in establishing a home.

Bracken

This substation was selected in 1935 and is located in the southwest corner of the province. The soil is a mixture of Echo and Haverhill clay loam of undulating topography. There are a few burnout spots in the more level areas and considerable gravel and stones, particularly on the knolls.

This area is subject to early June frosts and severe drought in July. Early maturing crops appear to be essential so as to be nearly mature before the extreme July drought.

Grain is the principal source of revenue, but a few livestock are kept. An excellent poultry flock has been established at this station and egg production has been high each year.

A dam was built at this station, which makes it possible to irrigate the garden in years when there is sufficient run-off to fill the dam.

A small shelterbelt had been started before this station was established, and since then considerable planting has been carried out so as to provide adequate protection to the buildings.

Carmichael

This station was selected in 1935 and is located on the bench of the Cypress Hills. The soil is dark brown clay loam of undulating topography. Part of the farm is quite stony, making it difficult to work.

Rainfall is the highest of any of the substations in southwestern Saskatchewan, but this station is subject to July drought which frequently reduces crop yields considerably.

Grain growing is the main source of revenue but cattle and hogs have always been an important side-line. Special attention is given at this station to the garden. The entire farmstead is surrounded by a good shelterbelt which collects snow, so even in dry years sufficient vegetables are produced for home use. A root cellar adjacent to the garden is used for storage. A small orchard of tree and bush fruits was established before the station started, and this has been extended so that plenty of fruit is being produced.

A dugout 100 by 50 feet and 12 feet deep was put in adjoining the shelterbelt. This supplies water for home use and for stock-watering when required.

Fox Valley

This station was operated as an Illustration Station from 1927 to 1935. In 1935 it was re-organized on the basis of a substation. The soil is a silty loam of fairly level topography and is very subject to erosion.

Since this station is located in one of the driest areas of the province, drought and soil drifting are the major problems.

Grain growing is the main source of revenue, with cattle as an important sideline. Sheep were kept for a number of years but were finally sold due to the difficulty of maintaining an adequate fence.

A shelterbelt has been planted on two sides of the farmstead to provide some shelter from the winds.

A good sized dugout was dug in the pasture to ensure an adequate water supply for livestock.

Gravelbourg

The original operator of this station when it was started in 1935 was H. Pinsonneault. Since his death in 1946, the substation work has been carried out by his three sons.

The soil is clay with level topography and is free of stones. Although the soil has drifted considerably at one time, there has not been any serious soil drifting on this station since its inception as a substation, due largely to sound cultural practices carried out by the operator.

While grain growing is the main enterprise and chief source of revenue, sufficient livestock are maintained to make a well balanced farm.

Considerable attention it always given to keep everything tidy and to the construction of efficient buildings and adequate shelter. The original shelterbelt has been replaced by more permanent trees such as elm, ash, and evergreens.

There were originally two dugouts at this Station. A third one was constructed to ensure an adequate water supply so as to be able to haul water for the garden when required.

Kincaid

Since this area was considered to be in the centre of the drought area, the station was selected in 1935. The soil varies from clay loam to silty clay loam. Parts of the farm are quite stony. Soil drifting and drought have been a serious problem in this area in the past.

Grain is the chief source of revenue. Since it is difficult to obtain good water in this area, livestock on the farm has been kept down to fairly small numbers.

Home improvement has always been a special feature at this station, and everything possible has been done to make the home comfortable and attractive. The shelterbelt has been expanded to surround the entire farm yard. A crested wheat grass lawn and a number of shrubs have been planted around the house.

In 1936 a dug-out and dam were constructed in the pasture, and this provides a water supply for the livestock during the summer. Winter water supplies are obtained from cisterns in the house and barn.

Limerick

This station was also started in 1935 due to the serious soil drifting in the area. The soil is a clay loam of fairly level topography. The land is very stony; many of these stones are too small to pick. This stony condition makes it difficult to use anything but disk-type implements for cultural work, and breakage of machinery is high.

Grain is the chief source of revenue. Both cattle and hogs are kept on this farm but chiefly to supply the home. Poultry production has been an important side-line at all times, and considerable revenue has been obtained from this source.

The operators have been successful in establishing a good orchard, which usually supplies an abundance of fruit. The original shelterbelt has been extended to surround the farm yard and has made good growth.

A dam was constructed in the pasture before the station was established, and this has been improved by the addition of a new spillway. This dam furnishes a good supply of water all the year round.

Pambrun

This is a relatively new station, being started in the spring of 1946. The soil ranges from loam to clay. Although drought and soil drifting are the major problems in this area, the topography of the land is such that there is a serious problem of water erosion. The substation is ideally located to study this problem, since the source of most of the water causing erosion on the farm is on the land owned by the operator.

Grain growing is the main source of revenue. Considerable attention has already been given to expanding the shelterbelt and to planting shrubs and flowers to improve the general home surroundings.

Riverhurst

Illustration Station work was carried out at this station from 1922 to 1935. In 1935 the station was re-organized under the P.F.R.A. as a substation.

The soil is a loam of fairly level topography. Precipitation at this Station is usually considerably lower than on most parts of southwestern Saskatchewan, and consequently drought is the main problem in crop production. Although soil drifting has been severe at times, it is not as serious as it has been in many other parts.

Grain growing is the main source of revenue. Dairying and hog production used to be an important side-line, but a shortage of labour forced the operator to discontinue these enterprises.

The operator is quite interested in the production of tree and bush fruits, and a fair-sized fruit plantation has been established. There is a good shelterbelt around the farmstead, and this has been improved by cultivation of the borders and keeping the dead wood cut out.

Shackleton

This station was started in 1939 and is located three and one-half miles west of the town of Shackleton. The soil varies from silty clay loam to clay of undulating topography. Soil drifting has been very severe on this area, and this combined with drought is the major problem.

Grain growing is the main source of revenue, but sufficient livestock are maintained on the farm to supply the home and to supplement the farm income.

The farm yard and garden are surrounded by a good shelterbelt. Some additional plantings have been made, especially evergreens, ash, and elm to add permanency to the belt.

A dugout 120 by 60 feet and 14 feet deep was put in to ensure an adequate water supply for the livestock. This dugout is also used for irrigating the garden.

Shaunavon

The soil at this station is a mixture of Cypress and Haverhill clay loam. Although the topography is reasonably level, there are numerous small pot-holes which cut up the fields considerably. Drought, soil drifting and insects, particularly sawflies and grasshoppers, have been the major problems. At present considerable attention is being given to the production of winter wheat.

Grain is the chief source of revenue. Sufficient livestock are maintained on the farm to supply the home. Pastures have been seeded to cultivated grasses, and pot-holes have been seeded down to provide hay for winter feed.

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The shelterbelt has been extended so as to surround the entire farm yard.

A dugout inside the shelterbelt ensures an adequate supply of water for the livestock and can also be used to irrigate the garden.

Tompkins

This station was started in 1935. The soil is quite variable, ranging from fine sandy loam to silty clay loam.

Part of the light soil area was seeded down to permanent grass and part is being cropped continuously to prevent further soil drifting.

Although grain growing is still the major enterprise, livestock is an important feature at this station. The operator has considerable grazing land adjacent to the main farm, and this is being used to develop livestock, particularly sheep.

A good poultry flock is maintained, and this provides considerable revenue.

The operator had planted a good shelterbelt before the station was started, and since then additional trees and shrubs have been planted. Tree and bush fruits have also been planted, and these provide an abundance of fruit in most years.

Tugaske

Illustration Station work was started at this station about 1921. In 1935 is was re-organized as a substation. The station is located just inside the dark brown soil zone and the soil is a light loam. Although rainfall is usually slightly higher than most of the other stations, it is still subject to severe droughts. Soil drifting has been severe in this area and, unless the land is carefully worked, this problem can be serious again.

Grain growing is the major enterprise, but livestock occupy an important place in the farm economy. The operator has established a fair sized herd of purebred Shorthorn cattle, and this provides considerable revenue. Hogs and poultry also provide a certain amount of income.

In order to ensure a feed supply, at least one-half the seed acreage consists of coarse grain.

The small original shelterbelt on this farm has been extended so as to furnish adequate protection to the home and other buildings.

Valjean

This farm originally consisted of 230 acres of land, but in recent years an additional 160 acres of pasture land have been added. The soil is a fine sandy loam and is moderately rolling. This farm was taken over as a substation in 1935.

An attempt was made to farm this land in a two-year rotation of fallow-crop, but due to serious soil drifting, it was found necessary and advisable to follow a system of continuous cropping on most of the area.

Although grain growing is the major enterprise, only about one-half of the revenue is derived from this source. The remainder is obtained from livestock and poultry.

Considerable interest has been shown in improving the farm home surroundings, and each year additions have been made to the tree plantation. Tree and bush fruits have also been established and these are providing some fruit each year.

Sales of Seed Grain by Substations

When the substations were started, it was recognized that one means by which a substation could directly serve a district was to act as a supply of good seed grain of the latest recommended varieties. In order to make this policy effective, small quantities of pure seed of the latest recommended varieties are

periodically sent to the operators for increase purposes. The seed is increased on the substations as rapidly as possible for distribution in the district. Prices charged by the operators for this grain have been only slightly above market price so as to encourage farmers to obtain good seed.

Detailed records as to the number of bushels of grain sold have been kept since 1940. These records show that there has been a yearly increase in the number of bushels of grain sold and the number of farmers purchasing seed. The total sales of grain and grass seed for the 8-year period, 1940-1947 inclusive, are presented in Table 34.

TABLE 34.—SALES OF SEED BY SUBSTATIONS, SOUTHWESTERN SASKATCHEWAN
1940-1947 inclusive

Station	Wheat	Oats	Barley	Rye	Flax	Grass Seed
	bu.	bu.	bu.	bu.	bu.	lb.
Bracken	7,560	4,649	547	-	120	1,450
Carmichael	11,614	3,294	3,725	61	2,039	3,210
Fox Valley	3,524	1,916	1,770	156	-	-
Gravelbourg	8,805	3,298	2,154	-	-	-
Kincaid	17,823	3,876	2,592	-	-	-
Limerick	3,969	1,954	3,983	-	-	1,220
Riverhurst	3,327	2,775	1,192	-	-	5,250
Shackleton	8,864	1,462	2,148	-	264	-
Shaunavon	8,530	2,395	3,580	-	516	-
Tompkins	3,045	829	1,144	600	10	1,025
Tugaske	6,288	2,471	5,645	5	247	372
Valjean	1,387	360	160	435	102	-
Total	84,736	29,279	28,640	1,257	3,298	12,527

The figures show that during the past eight years 151,913 bushels of grain and 12,527 pounds of grass seed were sold for seed purposes. It is through this policy that rapid distribution has been made of such varieties as Thatcher, Apex, and Rescue wheat; Ajax oats; Prospect and Titan barley; and Royal flax.

TABLE 35.—AVERAGE COST OF OPERATION PER ACRE—1943-1947
Substations—Southwestern Saskatchewan

Operation	Number of Reports	Average Cost	Highest Cost	Lowest Cost
		$	$	$
Single disk	26	0.22	0.33	0.16
Double disk	5	0.37	0.45	0.24
Cultivator	30	0.45	0.74	0.29
One-way disk	46	0.57	0.83	0.38
One-way seeder	24	0.56	0.85	0.36
Drill	34	0.38	0.62	0.26
Drag harrow	7	0.16	0.19	0.12
Noble blade	23	0.51	0.65	0.30
Rod weeder	19	0.35	0.60	0.14
Binder	9	0.87	1.27	0.45
Swather	24	0.35	0.50	0.21
Header	3	0.87	1.00	0.64
Combine	49	1.02	2.03[1]	0.46[2]

[1] Crop badly damaged by sawfly, part cut one way.
[2] Picking up 28-foot swath.

Cost of Operating Farm Machinery

In connection with the studies of cost of producing wheat, records have been kept on the cost of individual operations. The cost of operation figures presented in Table 35 include depreciation, repairs and interest on equipment, gas, oil, grease, and labour. It will be noted that there is considerable variation between the highest and lowest cost per acre for each machine. These variations are due to such factors as size of equipment, rate of travel, moisture conditions of the land, and depth of operation in the case of tillage machines.

It must be pointed out that these figures are the actual costs of operating the various machines on the substations. They are not intended to be used as a basis for custom rates, although they do give an indication as to what may be considered a reasonable basic charge.

TABLE 36.—AVERAGE COST OF THE ITEMS ENTERING INTO THE COST OF PRODUCING WHEAT, (1944–1947 inclusive)

Substations—Southwestern Saskatchewan

Item	Cost of Fallow			Total Cost Crop and Fallow		
	Average 62 Station Years	Highest Station Average	Lowest Station Average	Average 52 Station Years	Highest Station Average	Lowest Station Average
	$	$	$	$	$	$
Use of land, buildings and taxes	1.14	1.69	0.57	2.49	3.70	1.22
Use of machinery	0.67	1.13	0.53	1.91	2.44	1.50
Man labour	0.34	0.72	0.22	0.83	1.86	0.54
Gas, oil, grease	0.34	0.59	0.17	0.74	1.11	0.35
Seed	–	–	–	1.57	2.65	1.13
Threshing	–	–	–	0.31	2.17	0.00
Hauling	–	–	–	0.34	0.72	0.10
Interest on net cost	–	–	–	0.23	0.36	0.14
General farm expense	0.24	0.40	0.13	0.51	0.80	0.26
Total	2.73	4.53	1.62	8.94	15.81	5.24

Cost of Producing Wheat on Fallow

Figures on the cost of producing wheat have been recorded at the substations for the past 11 years. A more detailed study of the various items considered in the cost has been carried out during the past 5 years. The results of this work are presented in Tables 36 and 37.

Table 36 shows the average cost of the various items that enter into the cost of production. It also shows the lowest and highest average cost per station for the various items, or the variation in cost of individual items from one station to another. These figures are valuable in that they show the relative cost of the individual factors to the total cost. For example, use of land, buildings and taxes make up 41 per cent of the total cost; use of machinery 25 per cent; and gas, oil, and grease 12 per cent. These figures include cash expenses, depreciation and repairs on machinery and an interest charge of 5 per cent on the total investment associated with crop production. They do not include a charge for management of the farm business.

Table 37 presents a summary of total cost of fallow and crop and fallow for the individual stations, as well as a comparison of total cost for the 5-year period from 1943 to 1947 as compared with the 12-year period 1936-1947. It should be pointed out that the substations do not necessarily indicate the average cost of producing wheat, but rather show what has been done with reasonably good management and equipment.

It will be noted that cost of fallow ranges from $2.08 to $3.51 per acre, and crop and fallow from $6.90 to $10.69 per acre. Some of the factors causing these variations are value of land, size of farm, method of working the land, method of harvesting, and distance from market. Since each of these factors may vary widely from farm to farm, it is only natural that there would be wide variations in cost per acre from one farm to another.

Although there are wide variations from one station to another, it is interesting to note that there is not much variation in the average cost beween the 5-year and 12-year periods. The only plausible reason for this appears to be greater efficiency of production. This increased efficiency can be partly attributed to change in power set-up from horses to tractors on some farms and to greater efficiency of modern equipment.

A comparison of cost of fallow and cost of crop and fallow indicates that the cost of fallow is approximately one third of the total cost. With modern methods of production, crops on fallow can be handled as cheaply as crops on stubble. Hence the cost of producing wheat on stubble would be approximately two-thirds of the cost of a crop on fallow.

TABLE 37.—AVERAGE COST PER ACRE OF FALLOW AND COST OF PRODUCING WHEAT ON FALLOW

Substations—Southwestern Saskatchewan

Station	5-Year Average		12-Year Average
	Cost of Fallow	Cost of Crop and Fallow	Cost of Crop and Fallow
	1942-1946	1943-1947	1936-1947
	$	$	$
Bracken	2.13	6.91	7.13
Carmichael	2.70	8.94	8.90
Fox Valley	2.08	6.90	7.43
Gravelbourg	3.51	10.49	10.26
Kincaid	2.84	8.83	9.05
Limerick	2.79	9.06	8.82
Shackleton	2.53	7.94	7.71(1)
Shaunavon	2.99	9.55	8.89
Tugaske	3.13	10.69	10.73
Valjean	3.07	10.62	9.75

(1) Nine-year average.

Land Utilization

When the substations were first started in 1935, the acreage seeded to coarse grain was largely determined by the feed requirements of the livestock kept on the farm. In addition most of the coarse grains were sown on stubble land. Experiments with dates of seeding wheat, oats and barley indicated that oats and barley sown early on fallow would outyield wheat in pounds of grain per acre in most areas. The realization of this fact lead to a gradual change in the cultural practices regarding these crops. With the big demand for coarse grains during the war, there was a marked increase in acreage seeded to these crops.

In order to study the trends in acreage and production of various crops, a project on land utilization was started in 1943. The utilization of land at the substations in 1947 is presented in Table 38. This table indicates that wheat is still the major cash crop. With the mechanization of the farms, the acreage seeded to oats has been greatly reduced. Barley acreage, however, has been maintained at near the wartime level at the substations, and is much higher

than the prewar level. This is largely due to the fact that farmers have realized that barley can be grown as a commercial crop in competition with wheat.

Flax acreage reached a peak during the war, but dropped off very rapidly within a few years largely due to the uncertainty of the crop. This crop will not compete with weeds such as Russian thistle and, therefore, yields of grain are uncertain.

The acreage of rye is confined largely to the lighter soil areas. The extent to which this crop is grown in other areas is determined by the relative price of rye and wheat.

TABLE 38.—TOTAL ACREAGE AND ACREAGE IN VARIOUS CROPS—1947

Substations Southwestern Saskatchewan

Station	Farm	Crop Land	Fallow	Hay and Pasture	Misc.[1]	Wheat	Oats	Barley	Flax	Rye
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres
Bracken	1,424	702	522	95	105	532	55	115	–	–
Carmichael	1,600	829	484	272	15	476	121	72	72	160
Fox Valley[2]	780	260	276	234	10	193	17	44	–	6
Gravelbourg	1,280	610	594	58	18	478	48	84	–	–
Kincaid	960	445	453	47	15	290	32	123	–	–
Limerick	1,280	641	538	96	5	536	25	80	–	–
Pambrun	1,200	523	565	107	5	335	30	158	–	–
Riverhurst	960	393	383	160	24	226	18	149	–	–
Shackleton	640	308	276	46	10	232	2	74	–	–
Shaunavon	960	442	432	81	5	362	23	57	–	–
Tompkins	800	417	184	189	10	257	20	60	–	80
Tugaske	624	296	280	43	5	150	85	56	5	–
Valjean	390	139	20	221	10	50	16	20	4	49

[1] Misc.—Farmstead, waste land, etc. [2] Acreage 1946.

Study of Farm Business

A study of the farm business was started in 1939 to determine the relative returns from various enterprises so as to be able to appraise the soundness of the farm set-up. In order to keep accurate records, the operators send in weekly reports stating the cash revenue and expenses connected with each of the various enterprises on the farm. These statements are summarized at the end of the year, and suggestions as to changes in the farm set-up are made on the basis of these figures.

Table 39 indicates that through the five years 1943 to 1947 inclusive over 74 per cent of the total revenue was obtained from direct sale of grain and a very small proportion was derived from livestock in comparison with crop sales. The data on expenditures which cover the period 1944 to 1947 inclusive show that over 40 per cent of cash expense consisted of purchases of machinery and repairs, 16·93 per cent for gas, oil and grease, and 12·1 per cent was expended for hired labour. Purchases of machinery and repairs reached a high in 1947 when they comprised 49·92 per cent of total expenditure. This was due in part to purchases of new equipment. The proportion spent on hired labour has shown a tendency to decrease since 1944 from 16·2 per cent in that year to 9·11 per cent in 1947. The high expenditure for machinery in 1947 is reflected in a general inventory increase amounting to $1,226.69 in that year after allowing for depreciation. These data are presented in Table 40.

TABLE 39.—PERCENTAGE OF TOTAL CASH REVENUE AND CASH EXPENSES DUE TO VARIOUS ITEMS

Substations Southwestern Saskatchewan

Five-Year Average (1943 to 1947 inclusive)

Item	Per Cent of Total Cash Revenue	Per Cent of Total Cash Expenses[1]
Cattle and dairy products	9·51	3·66
Field crops	74·35	8·12
Hogs	5·57	1·92
Poultry	3·97	2·87
Sheep	0·96	1·58
Garden and orchard	0·10	0·13
Machinery and buildings	3·72	40·42
Taxes	–	9·29
Labour	–	12·10
Gas, oil, and grease	–	16·93
Miscellaneous	1·82	2·98

[1] Expenses: Four-year average (1944 to 1947 inclusive).

TABLE 40.—CHANGE IN AVERAGE INVENTORY—1946-1947

Substations Southwestern Saskatchewan

—	1946	1947	Change in Inventory + or −
	$	$	$
Land and buildings	17,109.09	17,197.27	+ 88.18
Livestock	1,650.82	2,144.05	+ 493.23
Feed and supplies	4,207.55	5,699.55	+1,492.00
Machinery and equipment	5,133.86	6,360.55	+1,226.69
Total	28,101.32	31,401.42	3,300.10

The table on changes in inventory indicates the capital investment involved in a farm set-up. Of the eleven stations included in this summary, four have an inventory value higher than the average indicated, while the other seven are lower.

LIST OF PROJECTS

Field Husbandry

F-101 —Wheat Continuously

TWO-YEAR ROTATIONS

F-105 —Fallow-Wheat
F-106 —Fallow-Fall Rye
F-559 —Wheat-Fall Rye
F-630 —Fallow-Oats
F-631 —Fallow-Barley
F-632 —Fallow-Spring Rye
F-633 —Fallow-Flax

THREE-YEAR ROTATIONS

F-107 —Fallow-Wheat-Wheat
F-109 —Fallow-Wheat-Fall Rye
F-525 —Fallow-Wheat-Oats
F-560 —Fallow-Wheat-Barley
F-635 —Fallow-Oats-Wheat
F-636 —Fallow-Barley-Wheat
F-637 —Fallow-Flax-Wheat
F-638 —Fallow-Wheat-Flax

CULTURAL AND CROPPING EXPERIMENTS

F-144 —Summerfallow Treatments
F-145 —Summerfallow Substitutes
F-146 —Stubble Treatments
F-161 —Weed Control Experiments including Rates and Dates of Seeding Wheat, Oats, and Barley
F-512 —Fertilizer Experiment
F-338 —Chemical Weed Control Experiments
F-651 —Crop Forecast Experiments
F-639 —Cultural Experiments with Flax

Cereal

I-Ce.11 —Wheat Variety Tests
I-Ce.25 —Breeding Wheats Especially for Sawfly Resistance
I-Ce. 6 —Barley Varietal Tests
I-Ce.30 —Production of Superior Varieties by Crossing
I-Ce. 5 —Oat Investigations
I-Ce. 9 —Flax Investigations
XIV-Ce.57 —Adapting, Designing, Inventing and Constructing Machinery and Apparatus for Cereals

COMPLETED PROJECTS

Ce.IX —Influence of Source of Seed on Cereal Crops

Forage Plants

Ag. 1 —Indian Corn—Variety Tests for Ensilage Purposes
Ag. 2 —Indian Corn—Variety Tests for Production of Grain
Ag. 92 —Triticum × Agropyron Hybridization
Ag. 95 —Crested wheat grass breeding
Ag. 111 —Alfalfa—Breeding of
Ag. 118 —Selection and Hybridization of Native Grasses
Ag. 119 —Selection and Hybridization of Native Legumes

Ag. 126 —Alfalfa—Variety Tests for Hardiness, Yield and Suitability
Ag. 161 —Sweet Clover—Variety Tests
Ag. 191 —Sorghum—Variety Tests
Ag. 246 —Annual Hay Crops
Ag. 251 —Millet—Variety Test
Ag. 252 —Crested Wheat Grass—Variety Test
Ag. 253 —Brome grass—Variety Test
Ag. 255 —Forage Crop Nursery
Ag. 264 —Perennial and Biennial Grasses and Legumes for Hay
Ag. 267 —Perennial and Biennial Grasses and Legumes for Pasture
Ag. 268 —Dates of Seeding Perennial Grasses and Legumes
Ag. 307 —A Study of Plants in Relation to Erosion Control
Ag. 308 —Spaced Rows Versus Close-Drilled Rows of Forage Crops for Hay, Pasture and Seed Production
Ag. 500 —A Taxonomic Study of the Native Flora of the Ranching Areas of Saskatchewan, Alberta, and Manitoba
Ag. 501 —A Study of the Growth Developments and Characteristics of the Principal Native Species.
Ag. 502 —The Classification and Distribution of Plant Communities in Western Canada in Relation to Climate, Soils, and Topography.
Ag. 503 —A Study of the Effects of Different Systems of Grazing Upon the Plant Cover of Range Areas.
Ag. 504 —The Revegetation of Range Lands, including Abandoned Fields, Saline Soils, and Eroded Areas such as Badlands, etc.
Ag. 505 —The Improvement of Pastures Through Surface Cultivation and Burning, and by the Application of Fertilizers, Herbicides, and Insecticides.
Ag. 506 —The Productivity and Grazing Capacity of Range Pastures.
F. 550 —Effects of Grasses and Legumes on Succeeding Crops of Wheat.
F. 555 —To Determine the Rate of Seeding Cereals Which Will Produce the Highest Yield of Different Fodder Crops.
F. 556 —Method of Seeding Grasses.

Agricultural Engineering

A.E.1.0—power and farm machinery

A.E.1.1220/1 —A draft study of a one-way disk on steel compared to one on rubber.
A.E.1.1222/1 —A study of draft and slippage relationship of rubber mounted tractors and conditions which effect their relationship.
A.E.1.2131/2 —Krause plow, analysis of
A.E.1.2131/3 —A study of the operation of the Krause plough at Lacombe, Alberta.
A.E.1.2171/1 —A study of soil pulverization by tillage implements.
A.E.1.2172/2 —Soil moisture conservation.
A.E.1.2173/1 —Relationship of soil moisture and density to penetrometer readings.
A.E.1.230/1 —Forage crops harvesting, handling and processing survey (Western Manitoba and Eastern Saskatchewan).
A.E.1.230/2 —(Same as above), (Western Saskatchewan and Alberta).
A.E.1.2410/1 —A pick-up baler use survey in Western Canada.
A.E.1.23111/1 —Combine loss study.
A.E.1.24112/1 —Straw saving devices.
A.E.1.241211/1—An analysis of the combination sweep and stacker, "Booster Buck".
A.E.1.241212/1—An analysis of the twine-type automatic typing pick-up baler (New Holland).
A.E.1.241212/2—A study of moisture content and density of baled hay on a basis of stages of curing, when baled with a pick-up baler.
A.E.1.2420/1 —Seed cleaning and treating plants.
A.E.1.251/2 —Jamesway sprayer.
A.E.1.252/1 —Western Crop 2,4-D Duster.
A.E.1.252/2 —Taintor Twomey 2,4-D Duster.

A.E.2.0—soil erosion

A.E.2.2411/1 —Experimental terraces.
A.E.2.2412/1 —Diversion ditch.
A.E.2.2412/2 —Diversion ditches.
A.E.2.2413/1 —Impounding ditches.
A.E.2.2421/2 —Strip contour cultivation.
A.E.2.2432/2 —Grassed waterways.
A.E.2.2432/3 —Grassed waterways.
A.E.2.2610/1 —Water erosion survey (Sask.).
A.E.2.2611/1 —Water erosion survey (Stewart Valley, Sask.).

A.E.2.2620/1 —Water erosion survey (Manitoba).
A.E.2.2621/1 —Water erosion damage and drainage survey of the Dauphin Lake, Man., Drainage Basin.
A.E.2.2630/1 —Water erosion survey (Alberta).
A.E.2.2640/1 —Water erosion survey (British Columbia).

A.E.3.0—WATER CONSERVATION

A.E.3.412/6 —Impounding dykes.
A.E.3.412/11 —Impounding dykes.
A.E.3.4133/1 —Development of pitting operations.
A.E.3.4133/2 —Pitting of range land.
A.E.3.510/1 —Dugout water filters.

A.E.4.0—IRRIGATION AND DRAINAGE

A.E.4.1123/1 —A study of oil as a canal lining.
A.E.4.123/1 —Spillway structures study.
A.E.4.140/3 —Water-measuring structures study (Portable water meter).
A.E.4.140/4 —Water-measuring structures study (Parshall flume).
A.E.4.21210/1 —Ditcher performance study (Robeco ditcher).
A.E.4.31/1 —Water requirements of crops.
A.E.4.331/1 —Seepage studies on the main supply canal, Swift Current Irrigation Project.
A.E.4.353/1 —Sprinkling irrigation study.

A.E.6.0—HYDROLOGY

A.E.6.2111/1 —Analysis of Dominion Water and Power Bureau Records for streams of the Southern Prairie regions.
A.E.6.2111/2 —Analysis of Dominion Water and Power Bureau Records for streams of the Peace River regions.
A.E.6.220/1 —Run-off measurement from a small agricultural watershed.

A.E.7.0—FARM ELECTRIFICATION

A.E.7.0/1 —Farm electrification studies.

A.E.8.0—FARM STRUCTURES

A.E.8.1240/1 —Total confinement rearing sheds for turkeys.
A.E.8.410/1 —Condensation of water vapour on interior surfaces of windows at the Dominion Experimental Station, Swift Current, Sask.

A.E.9.0—MATERIALS INVESTIGATIONS

A.E.9.1110/1 —A study of various treatments of exterior type quarter-inch fir plywood used as outside sheathing.
A.E.9.1110/2 —Methods and techniques used in treating exterior and interior surfaces of buildings.
A.E.9.1111/1 —Treatment of lumber for irrigation structures.
A.E.9.131/1 —Fabrication of wood arches.
A.E.9.213/1 —Rustproofing and corrosion preventive compounds in relation to agricultural machinery and equipment.

A.E.10.0—JOINT PROJECTS

A.E.10.1211/2 —Rejuvenation of crested wheat grass sod by common tillage implements.

A.E.11.0—SPECIAL EQUIPMENT

A.E.11.140/1 —Rotary soil sieve.
A.E.11.141/1 —Oven method versus Toledo method for determining soil moisture.
A.E.11.170/1 —Collapsible stand for reflectors.
A.E.11.170/2 —Drafting table.

A.E.11.20/1 —Travelling gantry for soil moisture investigation plots.
A.E.11.313/1 —Vertical plant row thresher.
A.E.11.40/1 —Tree planter.

COMPLETED PROJECTS PERIOD 1936—1948

A.E.1.0—Power and Farm Machinery

A.E.1.0 —Power and Farm Machinery
1. —Horse power requirements of various types of power take-off driven combines.
2. —Tests of pneumatic rubber tractor tires on farm tractors including tests using solution in tires, wheel weights and air pressure.
3. —Tests on high speed power take-off driven combine harvesters.
4. —Trials on harvesting of sunflowers with the combine harvester.
5. —Study of the cost of operating farm tractors, machines and equipment.
A.E.1.2121/2 —Robeco blade, analysis of
A.E.1.2132/1 —Massey-Harris one-way disk harrow, analysis of
A.E.1.214/1 —Graham-Paige Garden Rototiller, analysis of
A.E.1.2151/1 —Graham-Hoeme plow, analysis of
A.E.1.230/3 —Noiles automatic stooker, analysis of
A.E.1.251/1 —Buffalo turbine sprayer, calibration of and analysis of

A.E.2.0—Water Erosion

A.E.2.2412/3 —Diversion ditch.
A.E.2.2431/1 —Soil-saving dam.
A.E.2.2431/2 —Soil-saving dam.
A.E.2.2421/1 —Contour cultivation.
A.E.2.2432/1 —Grassed waterways.
A.E.2.2611/2 —Water erosion control survey, Hagen, Sask.
A.E.2.2631/1 —Water erosion control survey, Walsh, Alta.

A.E.3.0—Water Conservation

A.E.3.411/1 —Spreader dykes.
A.E.3.411/2 —Diversion dyke and contour furrows.
A.E.3.411/3 —Diversion dyke and contour furrows.
A.E.3.411/4 —Diversion dykes and impounding dykes.
A.E.3.411/5 —Spreader dykes.
A.E.3.411/6 —Terracing.
A.E.3.411/7 —Terracing.
A.E.3.411/8 —Spreader dykes.
A.E.3.412/1 —Impounding dykes.
A.E.3.412/2 —Impounding dykes (Syrup System) and Contour furrows.
A.E.3.412/3 —Impounding dykes.
A.E.3.412/4 —Impounding dykes.
A.E.3.412/5 —Impounding dykes.
A.E.3.412/7 —Impounding dykes.
A.E.3.412/8 —Impounding dykes.
A.E.3.412/9 —Impounding dykes.
A.E.3.412/10 —Impounding dykes.
A.E.3.4131/1 —Contour furrows.
A.E.3.4131/2 —Contour furrows.
A.E.3.4131/3 —Contour furrows.
A.E.3.4231/1 —Gravity irrigation, small projects.
A.E.3.4231/2 —Gravity irrigation, small projects.
A.E.3.4231/3 —Gravity irrigation, small projects.
A.E.3.4232/1 —Pump irrigation.
A.E.3.4220/1 —Dugouts.

A.E.4.0—Irrigation and Drainage

A.E.4.130/1 —Farm ditch structures study, check-drop.
A.E.4.130/2 —Farm ditch structures study, chute-drop.
A.E.4.130/3 —Farm ditch structures study, turnouts.
A.E.4.140/1 —Water-measuring structures study, rectangular weir.
A.E.4.140/2 —Water-measuring structures study, submerged orifice.
A.E.4.150/1 —Drainage structures study.

Animal Husbandry

A-952 —Supplementary feeding of pregnant ewes.
A-672 —Breeding Rambouillet sheep.
A-817 —Breeding Romeldale sheep.

Poultry

P-8 —Loss of weight in eggs during incubation.
P-65 —Ventilation—temperature of poultry houses.
P-122 —Open shelters for turkeys.
P-124 —Fertility and hatchability of turkey eggs.
P-141 —Blackhead in turkeys.
P-208 —Methods of handling and economy of production of turkeys.
P-232 —Methods and rations for fattening and finishing turkeys.
P-233 —Greenfeed crops—their management for poultry ranges.
P-264 —The use of rape-seed oilcake meal in starting and finishing rations for turkeys.
P-265 —The use of thiouracil, thiobarbital and other goiterogenic chemicals in the fattening and finishing of market turkeys.
P-266 —The relation of granulation of poult starter mashes to: (1) Pressure Necrosis, (2) Palatability, and (3) Gain in body weight.

Horticulture

H-261 —Annual Flowers—Variety Test.
H-274 —Herbaceous Perennials—Variety Test.
H-302 —Perennial Vegetables—Variety Test
H-790 —Flowering and Ornametal Shrubs—Variety Test.
H-793 —Bush Fruits—Variety Tests.
H-795 —Leguminous Vegetables—Variety Test.
H-796 —Bulbous Plants—Variety Test.
H-802 —Sweet Corn—Variety Test.
H-803 —Root Crops—Variety Test.
H-804 —Leafy Vegetables—Variety Test.
H-805 —Vine Crops—Variety Test.
H-806 —Solanaceous Vegetables—Variety Test.
H-815 —Tree Fruits—Variety Test.

District Experiment Substations

I.S.-W1-21 —Fallow-wheat rotation.
I.S.-W1-22 —Fallow-coarse grain rotation.
I.S.-W1-24 —Wheat-coarse grain rotation.
I.S.-W1-32 —Fallow-wheat-wheat rotation.
I.S.-W1-31 —Fallow-wheat-coarse grain rotation.
I.S.-02.10 —The effect of chemical fertilizers on cereals.
I.S.-02.12 —Root fibre and crop residue in soil improvement.
I.S.-03.05 —Cultural treatments for fallow.
I.S.-03.07 —Soil moisture studies.
I.S.-03.11 —Reclaiming shallow sloughs for hay production or pasture.
I.S.-04.02 —Water development studies.
I.S.-04.04 —Planning new farm buildings.
I.S.-04.08 —Whitewashing and painting of farm buildings.
I.S.-05.01 —Study of regional climatic conditions as related to crop production.
I.S.-05.02 —Records of regional precipitation.
I.S.-06.02 —Date of seeding.
I.S.-06.04 —Introducing suitable varieties of cereals.
I.S.-06.05 —Testing cereal varieties.
I.S.-06.06 —Production of pure seed grain.
I.S.-06.10 —Winter hardiness of fall seeded grain.
I.S.-06.13 —Control of wheat stem sawfly.
I.S.-07.01 —Testing mixtures for hay pasture.
I.S.-07.13 —Adaptation of grasses and legumes to varying regional conditions.
I.S.-11.02 —Development of the farm garden.
I.S.-11.08 —The establishment of a farm orchard.
I.S.-11.09 —Growing suitable varieties of small fruits.
I.S.-11.17 —Farm home beautification.

I.S.-11.18	—Farm shelterbelts.
I.S.-13.01 and 13.06	—Cattle production.
I.S.-13.07	—Swine production.
I.S.-14.00	—Poultry production.
I.S.-17.01	—Yield and cost of producing farm crops.
I.S.-17.04	—Study of farm business.
I.S.-17.07	—Establishment of feed and seed reserves.
I.S.-19.00	—Publicity.

BULLETINS AND PUBLICATIONS

1. Publication No. 720—Regrassing abandoned farms, submarginal cultivated lands and depleted pastures in the prairie areas of Western Canada.
2. Publication No. 738—An ecological and grazing capacity study of the native grass pastures in Southern Alberta, Saskatchewan, and Manitoba.
3. Publication No. 747—The effects of climate and grazing practices on short-grass prairie vegetation.
4. Publication No. 762—The identification of certain native and naturalized grasses by their vegetative characters.
5. Bulletin No. 769—The chemical composition of native forage plants of Southern Alberta and Saskatchewan in relation to grazing practices.
6. Guide to range sheep production.
7. Guide to grazing practices.
8. Pasture improvement for cheaper production (Prairie Provinces). Wartime Production Series. Spec. Pamphlet No. 56.
9. Results of Experiments, Swift Current Experimental Station—1931-1936 inclusive.