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DOMINION EXPERIMENTAL STATION

LETHBRIDGE

ALTA.

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

PROGRESS REPORT
1937-1946

IRRIGATION OPERATIONS IN A SUGAR BEET FIELD AT LETHBRIDGE.

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TABLE OF CONTENTS

PROGRESS REPORT 1937-1946
DOMINION EXPERIMENTAL STATION, LETHBRIDGE, ALBERTA

INTRODUCTION

A. E. PALMER

The Dominion Experimental Station at Lethbridge, Alberta, was established in 1906 on land where only part of the area could be irrigated with the result that both irrigation and dry land farming could be studied. Throughout the entire history of the Station, these two types of farming have been under investigation and are considered in most sections of this report.

The ten years covered by this report represented a period of extremes both in weather and social conditions. The beginning of the decade saw the final year of the greatest period of drought in the history of farming in this area. The other nine years have varied from good to poor but averaged about the same as the forty-six years during which weather records have been kept here. Social conditions felt the impact of the last years of the depression of the 1930's, the years of war, and the first years of post-war reconstruction.

These varied conditions influenced agriculture greatly. During the drought period of the early 'thirties low precipitation and insect damage denuded large acreages of farm land, exposing the surface to unprecedented wind erosion that threatened to make a desert of once fertile lands. It was impossible for farmers to meet the situation unaided, and the resources of the Lethbridge Station and other government agencies were marshalled under the Prairie Farm Rehabilitation Act of 1935 to help cope with the problem.

This Station, located in the Chinook Belt of southern Alberta, has been fighting wind erosion for many years and had developed effective control practices. When soil drifting became widespread these control methods were found useful in many parts of the prairies. However, they were not fully effective under all conditions, so continued attention has been directed towards improving methods for the control of soil erosion, both at the Lethbridge Station and on substations set up in various parts of the surrounding territory.

The revegetation of devastated areas, especially the regrassing of denuded and weed-covered, abandoned lands unfit for cultivation, became a major undertaking as many thousands of acres, once farmed, were abandoned during the prolonged drought. To study the situation effectively several areas of previously cultivated but abandoned lands were secured, on which regrassing experiments were established and successful regrassing practices developed.

The prolonged drought created an increasing demand for irrigation development and under the impetus of the Prairie Farm Rehabilitation Act plans have been made to bring additional large areas under irrigation. This has necessitated expanding the investigations in this type of agriculture not only in the study of cultural practices and fertility but especially in the development and improvement of crops suitable for irrigation farming. Canning crops, sugar beets, and soft wheat for pastry flour are expanding in their production; so it is that breeding, variety testing, and cultural experimentation with these crops are important activities.

The utilization as livestock feed of the by-products from sugar beets and canning crops has received attention in feeding experiments. More intense animal nutrition research is needed. The rearing of cattle and sheep on the

17609—2

extensive native grass ranches of the foothills and the dry, short-grass prairie, along with the fattening of this stock on irrigated farms, has become a great industry that brings millions of dollars into southern Alberta.

The great variety of agricultural production found in the territory served by this Station is reflected in the diversity of projects included in this report. In no area of similar size in Western Canada is there such a complexity of soil and climatic conditions, which vary from sub-humid in the foothills with black soil and lower temperatures, through the medium rainfall areas of the dark-brown soil zone, to the dry, brown soil zone, and into submarginal lands too dry for grain farming. Superimposed on these varied natural conditions is the practice of irrigation, which introduces new possibilities in crop production. It also adds new problems that must be studied in soil fertility, the use of water, drainage, alkali conditions, and increased weed populations.

There is need of a well-rounded research program at the Lethbridge Station to study regional problems. Anticipating the need for increased agricultural research, plans were formulated during the war years for improved service to agriculture after the cessation of hostilities, including increased research facilities and staff. Some progress in implementing these plans had been made before the end of 1946. About 5000 acres, mostly range land, but with irrigated land for winter feed production, was obtained in the Brooks area in 1943, to be used for studying the needs of the sheep industry. In 1945 an addition of just over 400 acres of irrigated land was made to the main station at Lethbridge. A Forage Crops Laboratory was developed and a new Wool Laboratory was built to further research in wool as it applied to the improvement of range sheep. Staff additions have been made, including an animal nutritionist, a wool technologist, an animal breeder, a weed specialist, and a range specialist.

SOUTHERN ALBERTA CLIMATE

The area served by this Station covers a wide range of climatic conditions and a corresponding variation in soil types. The main climatic characteristics are the Chinook wind, the abundant sunshine, and the relatively low precipitation with high evaporation. In fact, southern Alberta has more sunshine and more wind than any other populated area in Canada. These various factors set the pattern for agricultural development of the area. Equally important are the different degrees of influence of these factors in various sections. It is only within recent years that the effect of these local differences on agricultural development has been fully realized. Careful consideration must be given to them in future planning.

Differences in precipitation may be taken as an example. Annual average precipitation varies from 10·0 inches at Bindloss, in the eastern part of the area, 13·1 inches at Foremost in the south, 15·6 inches at Drumheller in the north, to 20·5 inches at Pincher Creek in the foothills to the west. These differences affect the type of farming practised, the social security of the farming population, and have a direct bearing on the demand for and success of irrigation farming. These differences in precipitation are caused to a certain extent by topographical features, of which the most important are the foothills to the west, the Milk River Ridge, which extends across most of the southern border of Alberta, and the Cypress Hills, which extend across the boundary of southeastern Alberta and southwestern Saskatchewan. All these heights of land have greater precipitation than the lower areas some distance from them.

Directly related to precipitation and its effectiveness is the prevalent southwest wind, the Chinook, which carries warm, Pacific air over the mountains and then sweeps across the southern prairie as a dry, warm wind. It makes the range areas useful for winter grazing by removing snow but at the same time increases soil drifting hazards on cultivated land by removing protective

snow cover, drying the topsoil, and when blowing hard it puts the soil into motion and causes trouble. In the summer this wind can shrivel the crops, as it sucks the moisture from plant and soil. Although the influence of the Chinook is felt throughout the southern region it is not equally severe in all parts of the area, and fairly definite lines of degree of effect are being delineated.

PLATE I—WIND AND WATER EROSION ARE MAJOR PROBLEMS IN SOUTHERN ALBERTA THAT DEMAND CONSTANT STUDY.

A. Photograph showing hillside where the top-soil, to the depth of the plough-sole, has blown away.

B. Photograph shows some of the sandier particles of this original top-soil deposited along a near-by fence line.

C. Water erosion from spring run-off in a summerfallowed field, near Lethbridge. (National Film Board Photograph).

The "Chinook area" is the high annual temperature zone of the prairies but within it marked differences exist at places separated by relatively short distances. The average daily maximum temperature at Lethbridge, from April to September inclusive, is 68·7° as compared with 72·7° at Medicine Hat, 70·3° at Foremost, 70·5° at Jenner, 70·8° at Brooks, 69·7° at Bassano, 66·8° at Hanna, and 66·5° at Calgary. These differences may not seem large but in terms of their effect on the crops that can be grown they assume major importance.

Detailed weather records are tabulated in the appendix.

FIELD HUSBANDRY

DRY LAND

In the dry land Field Husbandry work at Lethbridge, the principal effort has been directed toward developing and testing cultural practices that would control soil erosion, especially soil drifting, and would conserve the maximum amount of moisture in the soil. Rotation and fertilizer practices also have been investigated.

Ploughless Tillage

Ploughless tillage of summerfallows has been practised and included in investigational work since 1918. During the past 10 years methods for conducting ploughless tillage, so that the maximum amount of stubble and other plant residue could be left on the surface to form trash cover, have been the chief concern. Fields divided into strips of about one acre each in size have been used to test different cultural practices for the preservation of trash covers. Data on yields of wheat following different treatments are shown in Table 1.

TABLE 1.—COMPARISON OF YIELDS OF SPRING WHEAT ON DIFFERENT TYPES OF PLOUGHLESS FALLOW

Treatment of Stubble in Fall Preceding Fallow Year	Treatment of Fallow During Season	Average Yield in Bushels per Acre (6 years—1940, 1941, 1942, 1944, 1945, 1946)
None	Bladed	23·7
None	One-wayed	24·7
Bladed	Bladed	24·5

The data in Table 1 indicate that there is little difference in the six-year average yields of wheat following the different types of ploughless fallow. The bladed fallow has gone into the winter with a better trash cover anchored to the surface than the fallow which has been handled solely by the one-way disk and so has had greater protection against wind and water erosion. For that reason the blade weeder is preferred for this area. In seasons of above-average precipitation a better weed kill on the fallow may be obtained by using the one-way disk because a dry surface is required for an effective weed kill when using the blade cultivator.

PLATE II—SURFACE CULTIVATION FOR CONTROL OF SOIL DRIFTING.

A. Lumpy condition formed by single disking. This gives temporary control against drifting.
B. Trash cover left on surface following the use of a stiff-tooth cultivator.
C. Trash cover left on surface following the use of a one-way disk.
D. Trash cover and stubble left standing following the use of a blade cultivator.

After-Harvest Cultivation of Stubble

Three methods of fall cultivating stubble land to be seeded the following spring have been compared. The implements used and the average yields per acre for seven years of spring wheat following the respective treatments were:—cultivated with the blade weeder 14·0, one-way disked 13·0, basin listed 12·8, and no cultivation 12·6 bushels. In each case the spring preparation before seeding was to one-way disk and seed with a press drill.

The heavy blade weeder was the best implement for after-harvest cultivation as each year the weeds present were killed but the stubble was left standing erect to catch winter snow and to protect the soil against drifting. The one-way disk showed some benefit but if the stubble was light even a shallow stroke flattened it sufficiently to permit most of the snow to drift off. Basin listing helped some in conserving moisture but, when the basins were filled with dry top soil by spring cultivation, germination was spotty.

Cultivation immediately after combining was especially beneficial as it killed all weed growth in the stubble and prevented late-maturing weeds, such as Russian thistle, from maturing seeds. Delaying the cultivation reduced its benefit. Blading and one-way disking increased the fall germination of weed seeds about equally.

Preparing Stubble for Seeding

Ploughing, cultivating with a blade weeder, and cultivating with the one-way disk have been compared as methods for spring preparation of stubble land for seeding. In addition, seeding with a blade weeder equipped with drill spouts that scatter the seed under the blade, and seeding with the one-way disk with seeder attachment, have been compared with seeding with the press drill.

In these experiments the blade has not been a satisfactory implement for preparing stubble for seeding as spring storms often prevented the proper killing of the weeds by blading, whereas the one-way disk and the plough covered the weeds, and so a better weed control was secured. Ploughing before seeding has proved an excellent practice except in very dry springs when ploughing dried out the top soil and there was not sufficient rain to secure a satisfactory germination. Very dry springs have occurred twice during the 10 years. Spring ploughing of fallows, immediately ahead of the drill, where the soil had started to drift, has prevented further drifting. One-way disking, preceding drilling, has been a satisfactory method of preparing stubble land, and the use of the one-way disk with seeder attachment, has given about the same results as one-way disking and drilling with a press drill following the one-way.

Fertilizers

Mineral fertilizers have been applied to dry land wheat, on both stubble and summerfallow, in various combinations and at different rates of application.

On a wheat-fallow rotation, ammonium phosphate (11-48-0) at rates of 15, 30, and 50 pounds per acre, and triple superphosphate at rates of 20, 40 and 60 pounds per acre have been applied with the seed. An analysis of yields for a 12-year period shows that the 60 pounds per acre triple superphosphate treatment was the only one that produced yields significantly higher than the non-fertilized check, and the increase was not sufficient to pay for the fertilizer used.

The results on a three-year, wheat, wheat, fallow, rotation in which varying amounts of triple superphosphate, complete fertilizer, and potassium sulphate have been applied with the seed, both on fallow and on stubble, also indicated that differences in yields due to treatments were not significant.

Rotations

Six rotations were established on the dry land in 1911 and yield data from them have been recorded since 1912. Later other rotations were added. These rotations are listed in Table 2 with yields for 1937-46.

TABLE 2.—YIELDS ON DRY LAND ROTATIONS

Grain and alfalfa seed yields in bushels, hay and corn yields in tons.

Rotation	Crop	Yield per Acre	
		10-Yr. Ave. (1937-46)	10-Yr. Ave. per Acre of Land Used
A. Continuous Wheat	Spring Wheat	12·4	12·4
B. Two-year	Summerfallow		
	Spring Wheat	28·1	14·0
C. Three-year	Summerfallow		
	Spring Wheat	25·8	
	Spring Wheat	14·4	13·4
F. Three-year	Summerfallow		
	Winter Wheat	24·6	
	Winter Wheat	7·5	10·7
J. Six-year	Summerfallow (Manured)		
	Spring Wheat	17·0	
	Spring Wheat	14·3	
	Oats (Alfalfa and Crested Wheat Grass Seeded)	15·3	
	Alfalfa and Crested Wheat Grass Hay	0·45	
	Alfalfa and Crested Wheat Grass Hay	0·40	
M. Six-year	Summerfallow		
	Winter Wheat	32·3	
	Oats	25·2	
	Summerfallow (Manured)		
	Peas and Oats for Hay	2·08*	
	Oats	26·4	
S. Nine-year	Summerfallow (Manured)		
	Corn for Ensilage	3·97	
	Winter Rye	29·1	
	Summerfallow		
	Spring Wheat	24·4	
	Spring Wheat	15·5	
	Summerfallow		
	Peas and Oats for Hay	2·16*	
	Spring Wheat	14·2	
T. Ten-year	Summerfallow (Manured)		
	Winter Wheat	24·8	
	Oats	22·3	
	Alfalfa Seeding		
	Alfalfa Seed	0·14	
	Alfalfa Seed	0·20	
	Alfalfa Seed	0·10	
	Summerfallow		
	Corn for Ensilage	2·95	
	Spring Wheat	16·4	
Z. Five-year	Summerfallow (Manured)		
	Spring Wheat	17·1	
	Spring Wheat	11·5	
	Sweet Clover Seeding	0·13	
	Sweet Clover Hay	0·46	

*Nine-year averages only.

Some of the more complex rotations may not appear practical to farmers of the area but they are a part of a long-time study of crops in relation to soil protection and fertility.

Rotations A, B, C, and F, which contain wheat alone or wheat and fallow, are of most immediate interest to wheat farmers. Rotation A is of special interest, for although this field has produced a crop of spring wheat every year for thirty-five consecutive years, its crop in 1946 was slightly better than wheat

after wheat on rotation C which lies alongside of it. This reflects the fact that the field is as free of weeds and as fertile as the rotations containing fallows. The cultural practice used in recent years for grain following grain has been to cultivate with a blade weeder soon after combining the crop, then in the spring to one-way disk about 3½ inches deep ahead of the drill, and seed with a press drill. This usually produces a crop as clean of weeds as a crop on fallow.

It will be noted that there is little difference in the average yield from the total land used in the two-year rotation B and the three-year rotation C, while both of these have produced slightly more per acre than wheat continuously on A.

Other crops such as alfalfa for seed, corn for silage, and sweet clover, grasses, or alfalfa for hay, have been disappointing. However, peas and oats, as an annual hay crop, have yielded satisfactorily.

So far there is no noticeable benefit showing in these dry land rotations from the use of legumes or barnyard manure.

Irrigated Land

Use of Irrigation Water

Experiments to determine the proper use of irrigation water, for the purpose of formulating irrigation practice for various farm crops, were instituted at the Station early in its history. In 1922 projects were started to determine the proper use of irrigation water on wheat, alfalfa, and potatoes, and in 1926 sugar beets were added to this project. These experiments were concluded in 1938 and the results were published in the Dominion Department of Agriculture Farmers' Bulletin No. 10, Publication 509, entitled "The Use of Irrigation Water on Farm Crops". In 1939 similar experiments were started with barley and in 1941 seed peas and beans were added to these tests.

From the results of these investigations, irrigation practices have been formulated for the various crops. In general, it may be stated that it is found desirable to have a good supply of soil moisture in the soil in the spring and that all crops are improved if irrigation water is applied before the soil becomes dry enough to induce any wilting or check in the growth of the plants. Irrigation practices found suitable for various crops are described below:—

Wheat.—On medium and heavy soils in the Lethbridge area, one irrigation, applied in the previous fall or in the spring or early summer before the crop shows signs of needing water, produces good crops in years of average or above-average rainfall. If May and June are dry, a second irrigation at the late boot to early flowering stage is desirable. On light soils or those low in fertility, three irrigations are required in very dry years. Very early irrigation does not injure wheat on medium-textured or light soils and there is no advantage in irrigation after the kernels reach the milk stage.

Alfalfa.—It was found advisable to irrigate all alfalfa during the previous fall or in early May unless an unusually wet fall or wet spring is experienced If the spring is exceptionally dry, a second irrigation before the crop starts to bud is desirable. In most seasons an irrigation just before or immediately after cutting the first crop is required to produce a good second cutting. If a third cutting is to be harvested another irrigation usually is necessary immediately after the second crop is removed.

Potatoes.—In most seasons a good crop of potatoes may be raised on fertilized, medium-textured soils, with one irrigation given soon after the plants start to bloom and two more at intervals of three weeks. In very dry

years or on light soils, four irrigations at intervals of two weeks are desirable. It does not appear to be good practice to irrigate potatoes before the plants start to bloom unless the soil is dry enough to retard growth.

Sugar Beets.—It is essential to irrigate sugar beets frequently enough to prevent them from wilting to any great extent in hot weather. Occasionally it is necessary to irrigate because of a dry seed-bed but better stands are secured where careful preparation has preserved moisture near enough to the surface to germinate the seed. Where there is a good moisture supply in the spring, beets seldom require water until after the first cultivation following thinning. As the tops become larger, the water use increases rapidly and in dry seasons light irrigations at two- or three-week intervals appear desirable. It also is evident that irrigation should be continued until the first week of September to keep the beets fresh and crisp until they are dug. This late irrigation increases yields of both beets and sugar and produces crisp beets that keep better in the storage piles. It has been observed that, wherever beets are permitted to become injured by drought, both yield and sugar content are reduced.

Barley.—The desirable irrigation practices for barley seem to be similar to those recommended for wheat. It is essential to irrigate before the crop shows any injury from drought but late irrigations, after the kernels start to form, are not helpful and frequently cause lodging.

Seed Peas.—For seed peas one irrigation just before bloom produces maximum yields in most years. However, in dry years, a second irrigation two weeks later is helpful. Late irrigations, especially after the peas start to mature, are very undesirable and if the growth of the plants has been retarded because of dry soil conditions, an irrigation or a heavy rain at that time seems to stop growth immediately and to prevent the pea seed from maturing properly.

Field Beans.—Beans seldom require irrigation before they start to bloom but, when the spring season is very dry, an early irrigation helps. In most seasons at Lethbridge, one irrigation just before the plants start to bloom is sufficient but in dry years another irrigation two or three weeks later is helpful. Irrigation just before maturity does not increase yields or quality and interferes somewhat with harvesting if wet weather ensues.

Rotations and Sugar Beet Culture

Under the favourable moisture conditions made possible by irrigation, high crop yields can be obtained but this places a heavy drain on the natural fertility of the soil. Therefore, extensive and intensive studies have been conducted on means of maintaining or enhancing soil productivity through the use of crop rotations, barnyard manure, and commercial fertilizers.

Crop Rotations on Irrigated Land

Rotation "U".—From the information available it would seem that Rotation "U" is the oldest, continuous irrigated crop rotation, in North America. It was begun in 1911 as a ten-year rotation on a uniform ten-acre block that was broken out of native sod in 1908. The ten one-acre plots have been cropped as shown in Table 3. Where commercial fertilizer was used it was applied on one-half of each alfalfa plot in early spring and to one-half of the sugar beet plot at the time of seeding.

Data for the years 1937-46 are presented in Table 3 to indicate the yields obtained in the rotation and the effect of the fertilizer treatments.

TABLE 3.—AVERAGE YIELDS OF CROPS ON ROTATION "U" FOR THE YEARS 1937-46

Crop	Fertilizer Applied per Acre	Commercial Fertilizer Added	No Commercial Fertilizer Added
1st year alfalfa	100 lb. 11–48–0	2·05 tons	1·79 tons
2nd year alfalfa	15 tons manure	4·12 tons	2 28 tons
3rd year alfalfa		4·12 tons	2·66 tons
4th year alfalfa	100 lb. 11–48–0	4·30 tons	2·74 tons
5th year alfalfa		2·89 tons	1·68 tons
6th year alfalfa		2·32 tons	1·80 tons
Oats		109·4 bus.	104·3 bus.
Barley	15 tons manure	70·0 bus.	68·7 bus.
Sugar beets	100 lb. 11–48–0	17·98 tons	15·45 tons
Wheat		59·4 bus.	54·7 bus.

This rotation has demonstrated that the irrigated soils of southern Alberta can be maintained at a highly productive level by crop rotation and the use of barnyard manure and commercial fertilizer. Conversely, it has shown that high yields of alfalfa and sugar beets cannot be maintained without the addition of phosphorus.

For several years after this rotation first was laid down, excellent yields of all crops were secured. However, after approximately fifteen years of cropping the alfalfa yields began to decline. Experience in other irrigated areas suggested that the declining yields likely were due to a deficiency of phosphorus. Therefore, in 1933, the practice of adding 100 pounds of 11-48-0 ammonium phosphate per acre to half of each alfalfa plot was begun. By referring to Table 3, it will be noted that the application of fertilizer has caused a consistent increase in yield of alfalfa hay over the yield on the non-fertilized plot. The application of 15 tons of manure per acre to alfalfa, in the fall of the second year of production, caused no further increase in the yield the subsequent year for the half of the plot that received both manure and commercial fertilizer, but it did produce a noticeable increase for the half of the plot that received manure alone.

These results, when interpreted in the light of another experiment reported later, indicate that the residual effect of the manure applied to the barley stubble four years previously was great enough so that additional manure did not increase the yield with fertilizer. They indicate also that manure alone cannot maintain production at a high level.

The results are complicated somewhat by low yields of alfalfa in the fifth and sixth years of production, in spite of heavy fertilization, caused by a disease known as bacterial wilt of alfalfa. This will be discussed in detail elsewhere in this report.

It should be mentioned in passing that a well fertilized alfalfa crop has been observed to be a much more effective weed combatant than alfalfa grown on soil low in fertility. On Rotation "U", the plot halves that do not receive commercial phosphate fertilizer always are infested seriously by dandelions. On the halves of the plots that receive phosphate fertilizer the more vigorously growing plants shade the dandelions to the extent that their growth is almost negligible. Canada thistles in the alfalfa have been eradicated consistently, both on fertilized and unfertilized fields, by cutting the alfalfa for hay twice each year for three consecutive years. Perennial sow thistles have succumbed to the same treatment on fertilized but not on unfertilized fields.

The yields of grain on Rotation "U" have been high. This has been true on both halves of each plot and indicates that the cereal grains are not affected as readily as alfalfa and sugar beets by a deficiency of phosphorus. An analysis of the data for several years reveals that there is a consistent advantage in yield due to the application of commercial fertilizer.

The sugar beet yields on Rotation "U" have maintained a very high average. The ploughing under of 15 tons of manure per acre the fall before the beets are planted undoubtedly adds materially to the yield. However, it is interesting to note from the table that the addition of 100 pounds of fertilizer 11-48-0 per acre increased the yield from 15·15 tons to 17·98 tons per acre.

Rotation "U" as it was laid out and as it is still being conducted with six years of alfalfa, three years of cereal grains, and one year of hoed crop, is not a recommended rotation for this area at the present time. Sixty per cent of the land in alfalfa at one time is too much, and one intertilled crop in 10 years is not sufficient. Several new rotations now are being conducted at this station. These include sugar beets, potatoes, canning peas, and canning corn, along with the cereal grains and alfalfa. These rotations are expected to point the way toward a higher return per acre than can be expected from Rotation "U", while at the same time maintaining the soil fertility and controlling weeds.

Sugar Beet Rotations.—Canadian Sugar Factories Limited built a processing plant in Alberta in 1925 and that year approximately 7,000 acres of sugar beets were planted. The acreage in 1937 was 20,220 and in 1946 over 30,000 acres were harvested. The average yield per acre in recent years has been approximately twelve tons and the production of sugar per acre has compared favourably with that of any other beet-growing area.

Three irrigated rotations, primarily designed to study beet production, have been in progress for twenty years. These include one eight-year rotation (beets, beets, wheat, wheat and alfalfa, alfalfa, alfalfa, alfalfa, wheat), and two four-year rotations (beets, beets, wheat, barley, and beets, beets, wheat and sweet clover, clover summerfallow or clover hay). Each of these rotations has been conducted under four fertility treatments, namely: manure and phosphate fertilizer, manure alone, phosphate fertilizer alone, and no additions. In the sweet clover rotation two additional treatments have been included, green manure and phosphate fertilizer, and green manure alone. Manure has been applied in the fall before the first crop of beets, at the rate of 30 tons per acre in the eight-year rotation and 20 tons per acre in the four-year rotation.

Table 4 shows the ten-year averages (1936-1945) for yield of roots and percentage of sugar for two consecutive years of beets in each of the three rotations under the four fertility treatments. The first year of beets shown in the table followed grain; the second year, of course, followed beets.

TABLE 4.—SUMMARY OF TEN-YEAR AVERAGES OF SUGAR BEETS GROWN FOR TWO CONSECUTIVE YEARS AFTER GRAIN IN THREE DIFFERENCT ROTATIONS

Fertilizer Treatment per acre	8-Year Alfalfa Rotation				4-Year Cereal Rotation				4-Year Sweet Clover Rotation			
	Tons per acre		Sugar %		Tons per acre		Sugar %		Tons per acre		Sugar %	
	1st Yr.	2nd Yr.	1st Yr.	2nd Yr.	1st Yr.	2nd Yr.	1st Yr.	2nd Yr.	1st Yr.	2nd Yr.	1st Yr.	2nd Yr.
30 Tons Manure and 100 lb. Fertilizer T.S.P. -0-43-0.	19·31	19·32	15·72	16·26	19·93	19·11	17·30	17·18	20·36	19·56	16·73	17·07
30 Tons Manure Only	18·90	18·79	15·75	16·46	19·26	17·88	17·42	16·47	20·27	17·64	16·54	17·06
100 lb. Fertilizer Only T.S.P.-0-43-0	12·81	16·05	15·78	16·23	13·63	15·07	17·09	16·93	15·92	15·26	16·35	16·28
Check—No Additions	3·47	5·32	14·90	15·33	5·32	7·83	15·33	16·73	6·34	7·58	15·86	16·06
Green Manure and 100 lb. Fertilizer T.S.P.-0-43-0									16·17	15·97	16·57	16·54
Green Manure Only									7·42	7·50	16·13	15·83

The most striking feature of the data in Table 4 is the very large increase in the yield of beets brought about by the addition of either phosphate fertilizer or manure. As an example, in the four-year cereal rotation, 100 pounds of triple superphosphate per acre increased the yield 8·31 tons (5·32 to 13·63) and 30 tons of manure increased the yield 13·94 tons (5·32 to 19·26). The combination of fertilizer and manure did not increase the yield significantly beyond the yield secured from the addition of manure alone.

With relatively high fertility, such as occurs immediately after the addition of the manure, the yields from the three rotations are quite comparable, being 18·90, 19·26, and 20·27 tons per acre respectively. However, the heavier drain on phosphorus by the alfalfa rotation is manifested in the much lower yields from the check plots in the alfalfa rotation (3·47 tons per acre) than from the check plots of the other two rotations (5·32 and 6·34 tons per acre respectively). The yield of beets during the first year of the sweet clover rotation was from one to three tons per acre higher than the comparable yield under the different fertility treatments in the other two rotations. This probably is attributable to the excellent tilth that the partial summerfallow after sweet clover provides. Under the conditions of this experiment there has been no significant increase in yield of beets as a result of ploughing under the second crop of sweet clover hay as a green manure crop. This is illustrated by comparing the yield for green manure and fertilizer (16·17 tons per acre) with the yield for fertilizer alone (15·92 tons per acre).

In regard to the percentage of sugar of the beets grown under the different rotational systems some very interesting results have been obtained. Under Lethbridge conditions the application of manure to sugar beets does not depress the percentage of sugar. This is not in harmony with findings in some other beet-producing areas but the disagreement perhaps is attributable to climatic environment. It will be noted also that the beets grown in the alfalfa rotation have a consistently lower percentage of sugar than beets grown on comparable plots in the other rotations. The reason for this is not definitely known and further studies of this finding are under way.

It appears that the nitrogen content of the plots on the alfalfa rotation is so high as to reduce the sugar percentage in comparison with the cereal rotation. Apparently the condition is corrected to some extent by growing a crop of beets, since the second crop of beets has shown a significantly higher percentage of sugar than the first crop throughout all fertility treatments. Perhaps the same causative factors are operative to a reduced degree in the sweet clover rotation since the percentages of sugar in this rotation are consistently midway between the comparable percentages for the other two rotations.

The yields of the untreated check plots have continued to retrogress. The emergence of the seedlings has been much slower than on fertilized plots and the young plants have displayed much more susceptibility to insect damage and seedling diseases. While a potentially perfect stand usually emerged, the harvested stand seldom was more than 50 per cent and almost complete failures have been experienced at times on these plots.

A beneficial residual effect of manure and commercial fertilizer has been shown on the six crops following beets in the eight-year wheat and alfalfa rotation. Where the two treatments were combined, reasonably high yields were maintained throughout the rotation cycle. Manure alone was more effective than commercial fertilizer alone but neither one separately was as effective as when the two were combined. All three treatments maintained higher yields than the check plot, where no fertility additions were made. The yields from these plots show that wheat is not so sensitive as alfalfa to a phosphorus deficiency.

The value of the increased yields of all crops in the rotation, due to the application of manure, has been calculated, and the results indicate that manure would be worth more than five dollars per ton at the 1946 prices of agricultural products.

Methods of Handling Sweet Clover in a Sugar Beet Rotation

In 1937 an experiment was designed to study the various methods of handling sweet clover in a four-year rotation of beets, beets, wheat seeded down to clover, and clover summerfallow.

The following six treatments of the clover-fallow comprised the experiment:

(1) Plough clover in bud stage
(2) Plough clover in full bloom
(3) Cut one crop of clover hay and plough second crop
(4) Cut two crops of hay and plough
(5) Plough clover end of May and seed canning corn
(6) Black summerfallow (no clover)

The data obtained in this experiment indicate that ploughing the clover in the bud stage leads to a heavier yield of beets the following year than any other treatment. However, the yields have not been significantly better than ploughing in full bloom and the value of the hay in treatments 3 and 4 has compensated almost completely for the reduction in yield of beets. The yield of beets on plots that were black summerfallowed (without clover) compared favourably with sweet clover plots in the early years of the experiment, but later retrogressed, possibly because of the decrease in the supply of organic matter.

Treatment 5, in which canning corn replaces the partial summerfallow, following the ploughing under of the clover, is worthy of special note. In 1946, the clover was irrigated about one week prior to ploughing it under. Ploughing was done on June 5, when the clover was about 14 inches high, and approximately 5 tons of green forage per acre was turned under. The corn was seeded on June 11 and harvested as mature canning ears on September 16. The average yield of duplicate plots was 5·84 tons of canning corn per acre. The average yield in the district is approximately 3 tons per acre.

The yield of sugar beets following corn has not been materially lower than the yield following partial summerfallow after clover. However, beets growing on plots where corn was grown the year before showed decidedly more yellowing of the leaves than beets growing on plots that were summerfallowed. It seems safe to postulate that the nitrogen supply for beets was not so plentiful on the corn plots as on the clover summerfallow plots. However, there was no evidence that on these plots the nitrogen supply was so limited as to reduce the yield of roots. In a commercial field any deficiency that exists could be corrected readily by applying commercial fertilizer.

This method of producing a crop of canning corn, worth in excess of $80.00 per acre at 1946 prices, without significantly depressing the yield of beets the following year, appears to have considerable merit.

Sugar Beet Variety Tests

Tests of sugar beet varieties have been conducted continuously throughout the 1937-46 period. As a result of experiments conducted by this Experimental Station, and by the sugar processors, a change has been made during the last five years from "Sugar" or "Normal" to "Tonnage" strains. This change increased the production of sugar per acre. During the past decade many varieties have been tested. These were selected for testing in Alberta because of their promising performance in other areas. A few varieties have shown

sufficient merit to warrant additional study but none has shown striking superiority over those that are standard in this area, namely, Kuhn (a Dutch development), S.K.E. (a British selection), and Alberta 4 and 5, that are mixtures of S.K.E. and Kuhn, and probably display some hybrid vigour.

Table 5 shows the results of several varieties that have been under test during the ten-year period 1937-46.

TABLE 5.—RANKING* OF SUGAR BEET VARIETIES IN TESTS

Year	1938	1939	1940	1941	1942	1944	1945	1946
No. of Varieties in Test	5	12	12	8	4	7	7	10
Varieties—								
Alberta No. 4						3	3	
Alberta No. 5								1
S.K.E.						2	1	4
Kuhn	4	2	3	3	3	4	2	4
Midwest 4-B								2
U.S. 15	1	5	1	6				
U.S. 22		3	4	4				
G. Western 268								5
American No. 3							6	3
U.S. 33	3	8	10	7				
Dippe E.						6		
R. & G. Pioneer			9	5	4			

* Rank is based on sugar production per acre (thus, in a test of five varieties in 1938, Kuhn ranked fourth).

NOTE:—Data for 1937 are not included because the varieties tested that year were not continued on test. Data for 1943 are omitted because poor germination resulted in unsatisfactory stands of beets.

Most of the varieties produced in the United States have been developed to provide resistance to either Cercospora leaf spot or curly top or both of these diseases. Since neither one of these diseases (nor any others of consequence) occurs in southern Alberta the choice of variety rests entirely on production merit. This fact allowed wide latitude in the selection of varieties for testing. However, it seems evident that local climatic environment, especially length of day and cool fall weather, has the effect of increasing the percentage of sugar in the "Tonnage" strains and, therefore, these have proved superior to all recently developed American varieties.

Soil Drifting Control on Irrigated Land

The production of such crops as potatoes, sugar beets, and carrots, that leave a bare unprotected soil when harvested, has brought about a serious soil drifting hazard on many irrigated farms. Furthermore, partial summerfallows after sweet clover or canning peas leave additional bare ground that is subject to wind erosion. On an irrigated farm the best protection measure usually is late fall ploughing with a mouldboard plough. This has the added advantage of improving the tilth and increasing the ease of seed-bed preparation the following spring. Where fall ploughing has not been possible, listing with a cultivator usually provides adequate protection. Cover-crops have been used but have not become popular because of the necessity of spring ploughing and the attendant difficulties of preparing a suitable seed-bed for fine-seeded crops. Winter drifting has been checked on many occasions by listing the frozen ground with a one-way disk, converted into a lister by removing all but every fourth disk.

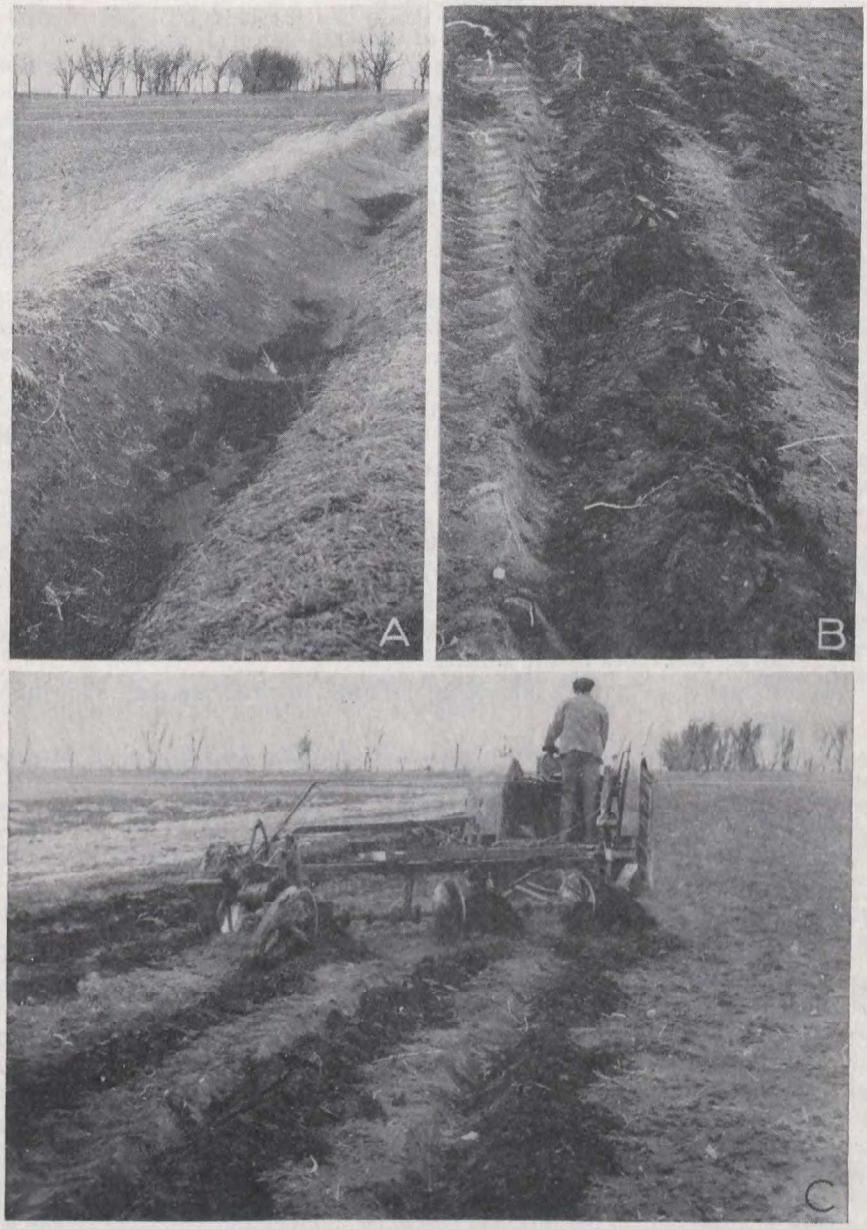


PLATE III—WINTER FARMING FOR SOIL DRIFT CONTROL.

A. Winter soil drifting on pea land showing irrigation ditch starting to fill with soil.

B. Close-up view of listed furrows which provide emergency control for soil drifting. The shallow cut of the furrow to the right was due to frost near the surface.

C. Listing in the month of January using a one-way with all but three disks removed.

17609—4½

Weed Control

Observations of the effectiveness of general cultural practices on weed control have been made ever since weeds first appeared in the Station fields. However, as the weed menace increased, not only on the Station but throughout the district, it became evident that special studies on methods of weed control were necessary. Consequently, in 1939, such work was begun and has been continued to the present time, except as interrupted by war conditions. When these studies were undertaken it was decided to concentrate attention on the most dangerous perennial weeds such as hoary cress, field bindweed, leafy spurge, and Russian knapweed. Some attention also has been given to annual weeds.

Both cultural methods and chemical methods of weed control have been studied at the Station, on a weed substation at Dalroy, and on infested areas throughout the district.

Cultural Control of Perennial Weeds

Field Bindweed.—Cultural work to control field bindweed has been somewhat limited and the results obtained are not clearcut enough to outline specific recommendations. However, the results are such that suggested recommendations can be given.

The following four methods of cultural control were tested.

(1) Blade weed to maintain black fallow

(2) Blade weed, allowing 5 to 6 days regrowth

(3) Blade weed, allowing for regrowth, using blade equipped with rods to elevate cut roots to the surface

(4) Ploughing as a first operation, followed by rod weeder, allowing for regrowth

There was no apparent advantage in attempting to bring field bindweed roots to the surface. By the end of the second year, treatment allowing for regrowth was as good as the black fallow. It took almost twice as many bladings to keep a black fallow as to allow for five to six days regrowth. Therefore, it would seem best to allow some regrowth and to cultivate at intervals of 14 to 16 days. The rod weeder was quite useful but it was found necessary to blade or otherwise loosen the soil occasionally to allow for proper use of the rod weeder.

It is thought that, when the first cultivation is made as soon as growth begins in the spring and cultivation is continued until freeze-up, field bindweed can be eradicated by the end of the third season.

Once the main stand of field bindweed has been eradicated, it is essential that vigilance be maintained and all seedlings be cultivated out before they become well established.

Russian Knapweed.—From small plot tests with Russian knapweed, where digging with a shovel was used to simulate ploughing, and hoeing was used to simulate cultivation, the indications were that complete control was possible by the end of the third or, at the latest, the fourth season. The number of diggings was reduced to half by allowing five or six days regrowth, and the allowing of some regrowth was just as effective if not more effective than digging to maintain a black fallow. Hoeing was not quite so good as digging for the control of Russian knapweed.

If the results from these tests are to be interpreted for field use, it is thought that ploughing or one-way disking would be slightly superior to duckfoot cultivating. Regardless of the type of implement used, some regrowth

should be allowed, giving an interval of approximately two weeks between workings. Such a practice would materially reduce the cost of eradication.

Cultural Control of Annuals

Russian Thistle.—Data from spring counts of Russian thistle seedlings on plots at the Station show a marked reduction in numbers of seedlings where any spring cultural work has been done to turn surface soil under.

Russian thistle seed generally does not mature until after mid-August. Germination tests have been made with seeds of Russian thistle from bladed and non-bladed stubbles. These tests show that where the blading has been done about mid-August the germination has been from 0 to 30 per cent as compared with 97 per cent germination for Russian thistle seed collected from non-bladed stubble. This is the basis on which one of the large farm operators in the district has found it possible to reduce the infestation of Russian thistle on several sections of land by blading the stubble immediately after the crop is combined in conjunction with sufficient cultivation to kill weeds in the fallow years. The decrease in germinability of seeds due to after-harvest blading results in a general decrease in the number of weeds appearing in the fields. The combination of reduced germination and a lower number of plants results in fields that are almost free of Russian thistle after a few seasons.

Stinkweed.—In an attempt to answer the question of how much moisture is taken from the soil by stinkweed during the early spring, before the land is cultivated prior to seeding, soil moisture determinations were made in weedy and non-weedy areas on April 16 and 17, 1942. At this time the stinkweed plants were up to two and one-half inches tall and making vigorous growth. The results of these determinations are shown in Table 6.

TABLE 6.—MOISTURE CONTENT OF SOIL IN WEEDY (STINKWEED) AND NON-WEEDY AREAS, APRIL 16 AND 17, 1942

Moisture Content, Per Cent

Depth	Heavy Infestation		Light Infestation	
	Weedy	Non-weedy	Weedy	Non-weedy
0–6"	10·64	14·78	10·52	12·91
6–12"	12·57	14·84	11·70	14·18
12–18"	14·63	15·51	13·60	13·89

It will be seen that the moisture content of the soil was reduced to a considerable extent by a heavy growth of stinkweed, even when the plants were relatively small. Working from these data, the calculated moisture loss from the heavy infestation amounted to approximately 123,000 pounds of water per acre, which is the equivalent of one-half inch of rainfall. The loss of one-half inch of rainfall is not to be overlooked, particularly in a dry spring when this amount of moisture may be essential for proper germination of a seeded crop.

The only possible means of reducing the moisture loss caused by early spring growth of stinkweed is to reduce the stinkweed stands. After-harvest and pre-seeding cultivations are advantageous in killing stinkweed and reducing the number of seeds in the soil. Care must be taken to prevent the weeds from maturing seed during the fallow years.

Chemical Control

Sodium Chlorate.—Sodium chlorate and "Atlacide" (a commercial preparation containing approximately 60 per cent sodium chlorate) were under test for several years for the control of perennial weeds. From these tests the following conclusions are of interest.

1. The effectiveness of Atlacide is almost directly proportional to its sodium chlorate content. Thus, it takes about 5 pounds of Atlacide to give the same results as 3 pounds of sodium chlorate.

2. Canada thistle and perennial sowthistle can be controlled quite readily by an application of 3½ to 4 pounds of sodium chlorate per square rod. Touch-up treatments may be necessary.

3. Field bindweed can be controlled with sodium chlorate applied at a rate of 4 to 5 pounds per square rod in mid-September. Re-treatments, where necessary, should be given in midsummer of the year following the original treatment.

4. Russian knapweed, though less susceptible than bindweed, can be controlled with a fall treatment of 4½ to 5½ pounds of chlorate per square rod. Though not fully tested, it is suspected that fall treatment followed by mid-summer re-treatment is more desirable than spring treatment.

5. Of all the perennial weeds found in southern Alberta, hoary cress is the most difficult to kill with sodium chlorate. The chemical should be used at a rate of 5½ to 6 pounds per square rod and applied in mid-September or later. One or more re-treatments usually are needed and these should be applied in midsummer of subsequent seasons. Hoary cress seems to develop an immunity to sodium chlorate if the first treatment is too light.

6. Sodium chlorate is best applied to the soil alone, rather than to the soil and weed foliage together. The chemical can be applied to the soil in a solution or as a dry powder with equal effectiveness. Dry applications are favoured as they save time and labour and also tend to overcome the fire hazard that attends the use of sodium chlorate solutions.

7. Sodium chlorate, at rates used for perennial weed control, sterilizes the soil for a period of from three to five years, the time depending on such factors as soil type, amount of organic matter, and leaching due to rain or irrigation water.

8. The use of sodium chlorate for perennial weed control is relatively expensive and is out of the question for large areas. The price of sodium chlorate usually runs at about 12 cents a pound and at this price a single application, at the rates suggested above, will cost from 42 to 72 cents per square rod.

Carbon Disulphide.—Carbon disulphide has been tested on different occasions for the control of field bindweed, leafy spurge, hoary cress, and Russian knapweed. In all tests the standard rate of application was used, that is, two ounces per hole, holes 18 inches apart in rows 18 inches apart with the holes being staggered in the rows. The Mack Anti-Weed Gun was used to inject the liquid into the ground and it worked very satisfactorily.

The following points may be listed from observations and results obtained from the various tests.

1. Under satisfactory conditions the roots of field bindweed, leafy spurge, hoary cress, and Russian knapweed are killed below the 2½ to 3 inch level, leaving "stubs" at the surface. These "stubs" may re-establish the weed stand but are killed readily by cultivation.

2. Treatment should be made when the soil is moist, having the equivalent of seed-bed moisture, so that no cracks are present on the soil surface and the holes can be sealed easily.

3. Treatments are best when made in midsummer, at which time the soil temperature is uniformly high, and assures even and fairly rapid volatilization of the liquid.

4. The effectiveness of carbon disulphide is equally high at almost any depth from 3½ to 6 inches if the proper conditions of moisture and temperature prevail.

5. Best results are obtained on medium-textured soils. The material dissipates too rapidly in sandy soils for proper weed-killing action and in very heavy soils does not spread enough to give complete kills.

6. Under most conditions prevailing in southwestern Alberta, the clear type of carbon disulphide has proved to be as effective as the "activated" material which is sold primarily for weed-killing purposes.

7. Carbon disulphide is a highly volatile and extremely inflammable liquid. The fire hazard attendant to the use of this chemical is one of the greatest disadvantages to its use as an herbicide.

8. The cost of carbon disulphide treatment is two to three times that of sodium chlorate treatment for material alone, with an added increase in cost of application. However, this chemical may be useful for small patches of perennial weeds because of its weed-killing ability, and due to the fact that it does not sterilize the soil.

2, 4-D.—A new chemical weed killer, 2, 4-dichlorophenoxyacetic acid (2, 4-D), appeared on the market in 1945, and since that time has been used widely for the selective control of annual weeds in growing crops. 2, 4-D is a hormone-like chemical and the application of relatively small amounts of the material to certain plants so upsets the growth as to bring about death. 2, 4-D can be obtained in any one of four different forms which are the free acid, sodium or ammonium salts, amine salts, and esters. For control of most annuals all the forms are equally effective, but for some of the more persistent perennials and woody plants the esters have proved to be slightly superior. The material is available for application as a dust or as a spray.

2, 4-D has been under test at the Lethbridge Station for control of perennial weeds but only one season's results are available at this time. Further work is necessary before definite conclusions can be drawn regarding the value of 2, 4-D for perennial weed control. However, there are some interesting points available from the work to date and these are listed below.

1. Seed formation in hoary cress can be prevented by applications of 2, 4-D if such applications are made some time before pods begin to form, at a rate of one pound of free-acid equivalent per acre.

2. Treatments of 2, 4-D to hoary cress, even at heavy rates, do not appear to disrupt seed formation if such treatments are given any time after the pods are well formed. The seed produced by such treated plants has been found to germinate as well as seed from untreated plants.

3. Hoary cress stands have been reduced materially by applications of two or more pounds of 2, 4-D free-acid equivalent per acre from early bud to full bloom stages, but no complete kills have been effected.

4. Of the types of 2, 4-D tested for hoary cress control, the sodium salt appeared to be slightly inferior to the amine salt and the ester.

5. Stands of perennial sowthistle treated at full bloom with four pounds of free-acid equivalent per acre were reduced by 95 to 98 per cent, as judged in the spring of the year after treatment.

6. For such hard-to-wet plants as perennial sowthistle best results were obtained with the ester type of 2, 4-D.

7. Very unsatisfactory results were obtained with 2, 4-D for the control of Canada thistle.

8. Seed formation of leafy spurge was prevented by one-half to one pound of 2, 4-D free-acid equivalent per acre when applications were made just prior to or at the time of flowering.

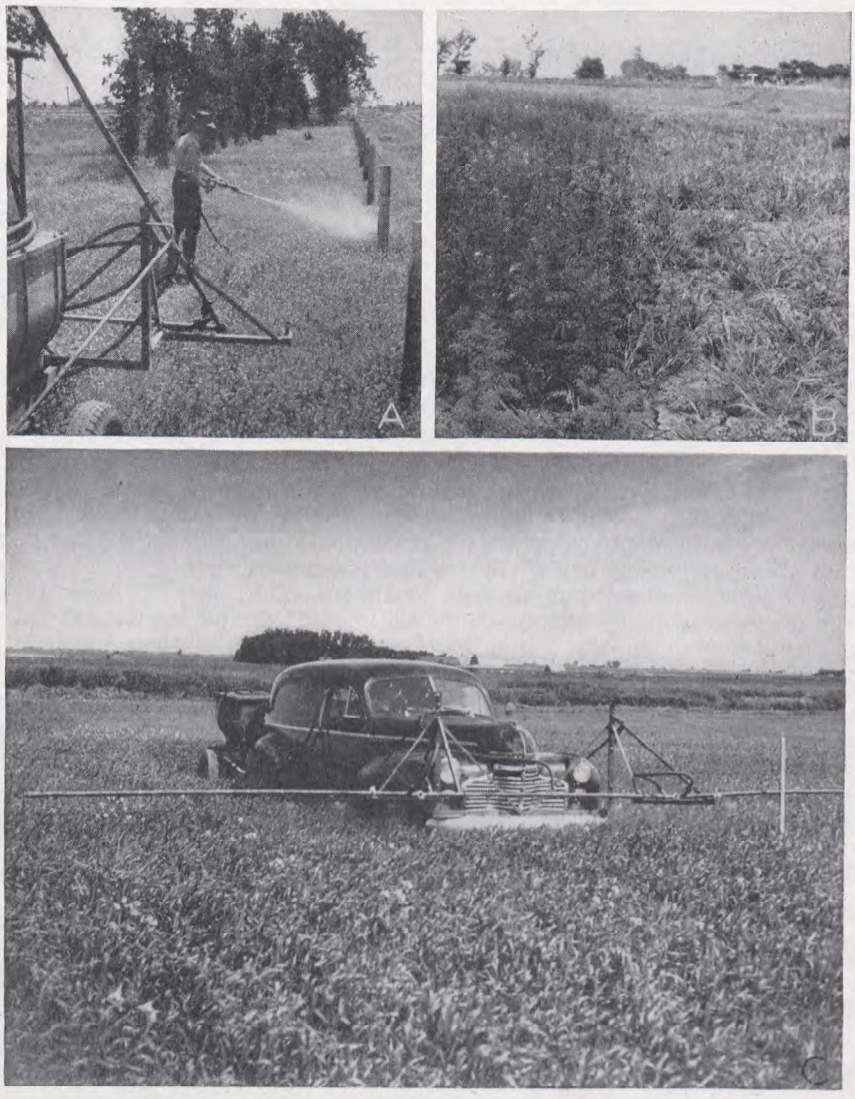


PLATE IV—CHEMICAL WEED CONTROL.

A. Applying 2,4-D with an orchard nozzle to weeds along fence line.

B. Photograph showing effects of 2,4-D dust treatment on flaxseed one month after application (untreated portion at left).

C. Experimental field sprayer for application of selective herbicides such as 2,4-D.

9. Stand reductions in leafy spurge infestations have been obtained only by very large dosages of 2, 4-D, and no complete kills were obtained even with two treatments in the same season.

10. Stands of field bindweed were reduced greatly by a treatment of two pounds of free-acid equivalent per acre applied at the early bloom stage.

11. First-year growth of ditch-bank willows was killed readily by the ester types of 2, 4-D.

12. Older ditch-bank willows, from 8 to 10 feet tall, were killed back to ground level with 2, 4-D esters.

13. Stands of cattail were reduced by approximately 80 per cent with 2, 4-D esters applied in mid-July at a rate of four pounds of free-acid equivalent per acre.

Machinery Development

The major work in the field of machinery investigation has dealt with the following:

(1) The elimination of hand labour in handling manure
(2) Haying machinery to reduce labour requirements
(3) A study of the performance of mechanical sugar beet harvesters.

Manure Loader

Requests for information on the construction of home-made tractor-mounted manure loaders led to the development of such a unit at the Station. Four basic principles were followed in its construction:

(1) Simplicity and ease of construction in small shops
(2) Convenience of attachment to the tractor
(3) Ease of control of both tractor and loader
(4) Sturdiness without excessive weight.

The loader has proved very satisfactory in operation and several hundred pamphlets on its use and construction have been distributed. It is capable of loading a standard 60-bushel spreader box in 5 to 7 minutes from either the pile or from the feed lot. Experience has brought to light two main points in the use of this type of loader:

(1) Careful attention should be given to front tire pressures, and to wheel and steering post bearings. When loading from the manure pile there is a definite danger of overloading the front end of the tractor.

(2) Caution should be exercised to avoid dumping large fork loads into the spreader box from any height greater than necessary as there is some danger of springing the frame of the box. During the winter large, frozen lumps of manure should be avoided as these impose an excessive strain on the spreader mechanism.

Haying Equipment

Sweep-Stacker.—War-time labour difficulties intensified the interest in labour-saving haying machinery. Coincident with the development of a combination sweep-stacker by some local mechanics, the Station built a similar unit to test out the practicability of certain design features and the performance of the machine in the field. To date a positive dog-type clutch with a friction holding brake has been the most successful of those tried. A simple levelling device for the fork was developed for this unit.

PLATE V—LABOUR-SAVING MACHINERY MADE AT THE LETHBRIDGE STATION FOR THE IRRIGATION FARM.

A. Power manure loader.
B. Automatic sweep stacker.

Sweep-Push-Rake.—A tractor, push-type sweep-rake also was built, using an "A" push-frame pivoted to the front of the tractor by clevises. The rear-end power winch from the manure loader was used to raise the fork to a height of 4 feet at the tips. Both the sweep-stacker and the sweep-rake were mounted on rubber as steel wheels were found to be too rough.

This combination of one sweep-stacker and one push-rake has handled 30 to 40 tons of hay per day with a four-man crew. This has been the experience

of the Station and checks closely with the results of a survey among sweep-stacker users. Demonstrations of these machines have been held and considerable interest has been aroused. Some doubt was expressed about their manoeuvrability. Once the steering knack is mastered excellent results in sweeping the field clean have been obtained. The two units operate together very nicely when the sweep-stacker is used primarily for stacking hay brought to within 200 feet or so of the stacks. Stacks 22 feet high, of any length, can be built easily by this method.

Sugar Beet Harvesting Machinery

In the fall of 1945, four John Deere 54A harvesters were brought into southern Alberta. In 1946, twenty-five more were obtained but for various reasons not all were put into operation. Also in 1946, two International and one Keist unit were given trials. However, since they were used for demonstration mainly, the results of the field survey study given here apply to the John Deere 54A units only.

Topping Efficiency.—The topping efficiency of the machines was compared with hand labour wherever both could be found working in the same field. All data taken were based on the operator's own adjustment except in two instances where obvious readjustment was indicated. The average machine efficiency was 95·4 per cent as compared with 96·3 per cent for hand workers. This difference is not considered significant so it can be concluded that with reasonable care, under average conditions, machine work was just as effective as contract, hand labourers who tend to become very mechanical in their work as the season progresses.

Dirt Tare.—A study of the dirt-tare records from over 600 loads of beets showed that there was very little difference in the amount of dirt hauled with the beets where hand topping was compared with machine-topped beets. However, the use of the hand fork for loading resulted in 6·7 per cent more dirt being hauled with both hand- and machine-topped beets than where a mechanical loader was used. Because of the tendency of some soils to form clods and to adhere to the beets it was found that machine-harvested and machine-loaded beets carried an average of 23·0 per cent dirt from silt loam soils compared with 16·0 per cent from fine sandy loam soils. No direct comparison was obtainable on heavier soils though weekly average tares of 30 per cent were found while extreme cases often ran higher than this on the daily deliveries. This would indicate that the machines studied will find their best use on the lighter soils.

Harvesting Costs.—The cost survey included 13 records comparing the harvesting machine without the loader and 4 records with the loader, to contract hand labour. The 1946 season was rather badly broken up by rain and snow which interfered with efficient operation, consequently the differences may be even greater in a normal season.

The machines harvested an average of 2 acres per day with maximum runs of 3 acres per day. The highest seasonal run was 50 acres. Machine-harvesting costs averaged 68 per cent of contract labour charges without the loader. Where the loader was used the comparison showed an additional 5 per cent decrease for the machines. Annual charges were made as follows: The harvester was depreciated over a 6-year period at 50 acres per year plus 10 per cent for repairs and interest. The loader was depreciated over a 10-year period. The obsolescence factor has been weighted rather heavily in arriving at these charges.

17609—5½

CEREALS

Dry Land

During the past decade experimental work with cereal crops on dry land has been confined mainly to winter wheat, winter rye, hard spring wheat, oats, barley, and flax. Flax was in short supply throughout the war years and higher prices in recent years have helped considerably to increase the acreage devoted to flax. In evaluating the various dry land cereals the tests conducted at the Lethbridge Station, at the ten District Experiment Substations, and tests on private farms have been considered.

Winter Rye

In the first few years of the past decade rye prices were down to such a low level that the crop had become very unpopular, except in the eastern portion of the district where, on account of drought, the production of other grain crops generally is more hazardous. However, during the later years of that period the price of rye rose rapidly to the point where it became double that of wheat. This naturally made it a more attractive crop to the farmers and the acreage devoted to it increased accordingly.

Variety tests of rye have been conducted at the Station on dry land for many years and results have indicated that Dakold, the variety generally recommended for Alberta, is no better yielder than a common strain of rye which has been selected and grown at this Station for many years. The respective yields for a three-year period were Lethbridge Common 29·22 and Dakold 23·34 bushels. However, Dakold is the only variety that is eligible for registration by the Canadian Seed Growers Association, and it is easier to procure good, pure seed of it than of any other variety.

Winter Wheat

The winter wheat area of Alberta generally is looked upon as being the southwestern corner of the province, extending north to Vulcan and east to Taber. Previous to the war, winter wheat was limited to relatively few producers but a favourable price differential during the war years and for the two years following has made it a much more popular crop in recent years. The scarcity of low-protein or pastry wheat in Canada was largely responsible for the increased price of winter wheat since it partially met the requirements of this class of wheat.

The labour shortage has been one of the farmers' greatest problems for several years and winter wheat has been quite helpful in solving it by extending the harvesting over a longer period and enabling farmers to be less dependent upon hired help.

In recent years farmers have become more conscious of the need to counteract soil drifting and many of them are using winter wheat for this purpose by seeding it early in August so that the ground goes into the winter with a good cover.

Damage from root-rot discouraged the growing of winter wheat in the early years of grain growing in the south and it was believed that the trouble resulted mostly from too early seeding. In order to avoid this difficulty it has been recommended for many years that seeding should be delayed until after the first of September. Investigations are under way to determine more accurately whether there is a definite correlation between early seeding and root-rot infection, and to see how much earlier the date of seeding can be advanced with safety. The present indications are that earlier seeding may be satisfactory.

Winter-killing of winter wheat is not a problem of great concern to farmers in the southwestern corner of the province. Crops may be thinned

out occasionally by it but total failures occur very rarely. At the Station the Kharkov variety has been used in the field lots and only two complete failures have occurred in the past thirty-five years. Over an eighteen-year period Kharkov winter wheat on summerfallow has given an average yield of 19·7

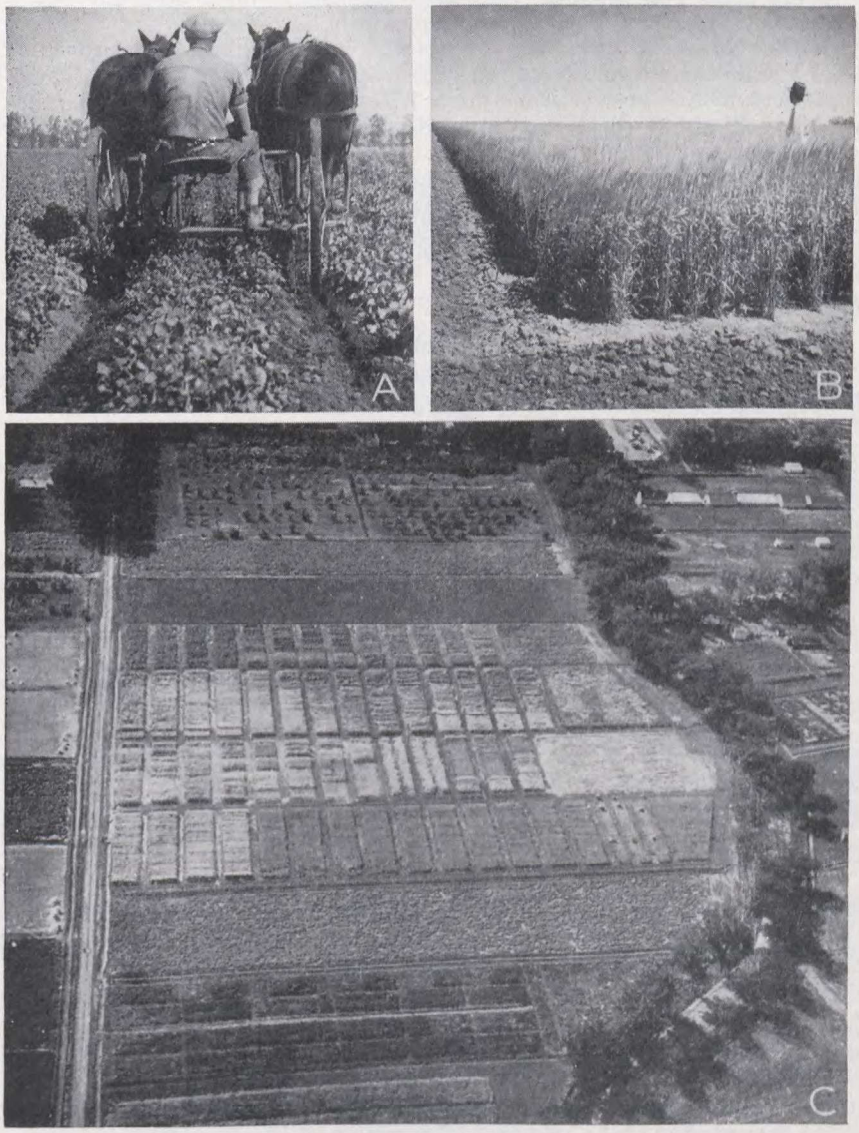


PLATE VI—CEREAL VARIETY TESTING.

A. Harvesting beans for seed.

B. Winter wheat test plots. Kharkov and Yogo are two leading varieties in southern Alberta.

C. Aerial view showing a portion of the cereal test plots at the Lethbridge Station.

bushels per acre compared with 18·1 bushels for Marquis spring wheat under the same conditions. Incidentally, winter rye in this same test has yielded 19·9 bushels per acre.

Variety tests of winter wheat have been conducted for many years and the average yields per acre of the three varieties most commonly used in the district for a six-year period (1941-1946 inclusive) were: Kharkov M.C. 22, 35·3 bushels; Yogo 35·0 bushels; and Jones Fife 33·6 bushels.

Kharkov M.C. 22 and Yogo are bearded varieties that have proved to be superior to all others tested from the standpoint of winter hardiness. These are the most commonly grown in southern Alberta. Yogo has the advantage of being less subject to shattering than Kharkov M.C. 22 but it has the disadvantage of being weaker in the straw. Jones Fife is a beardless variety and is preferred by many farmers on that account. However, it is definitely less winter hardy than the other two and has a decided tendency to shatter. Elite or registered seed of Kharkov M.C. 22 has been grown at the Station each year and has provided seed for pure seed fields in a number of districts.

Spring Wheat

For many years Marquis was considered the best variety of spring wheat for southern Alberta. However, in the past decade a few other varieties have been increasing in importance and consequently the acreage occupied by Marquis has been decreasing gradually.

Table 7 shows the average results obtained over a ten-year period for the five varieties most commonly grown in southern Alberta.

TABLE 7. VARIETY TEST OF HARD SPRING WHEAT

Dry Land

10-Year Average

Variety	Days to Mature	Length of Straw	Strength of Straw	Yield per Acre
		ins.	score*	bus.
Thatcher	105	34	10	33·2
Reliance	107	33	10	32·7
Red Bobs	105	35	10	31·9
Canus	107	34	10	31·8
Marquis E 32	108	35	10	29·1

* 10 indicates perfect score for strength.

Thatcher has been increasing in popularity in recent years as it has been a good yielder, is a little earlier than Marquis, and has no tendency to shatter. Its tendency to bleach under adverse harvesting weather probably is its greatest disadvantage. Reliance, a bearded variety, also has been a good yielder, particularly in seasons when moisture has been plentiful. Red Bobs is favoured by some growers but its chief disadvantages are its tendency to shatter and bleach. The severe shattering of Canus has practically eliminated it from the district. While Marquis has been outyielded slightly by the other four varieties, it still is grown extensively because of its greater ability to withstand harvesting hazards such as wind, rain, snow, and early frosts. Rescue likely will replace other varieties where sawfly damage is serious as it has stood up well against sawfly attacks in this territory but its lower quality and weaker straw make it undesirable where sawflies are not troublesome. Elite seed of Marquis has been produced annually.

Oats

For many years Victory has been the most important variety of oats grown in southern Alberta. Early maturity and resistance to rust are not so important in this area as in many other districts. Consequently, several new varieties that have become important elsewhere have not established themselves in southern Alberta to nearly the same extent. Erban has appeared to be one of the best of the newer varieties for dry land conditions. The average yields per acre of Erban compared with Victory and Legacy for a nine-year period are as follows: Erban 59·6 bushels, Legacy 56·8 bushels, and Victory 53·3 bushels.

Barley

During the past decade smooth-awned barley varieties have been much more in demand than they were formerly and several new varieties of this class have been introduced. All promising new introductions have been included in the variety tests conducted annually on dry land summerfallow.

The average results obtained over an eight-year period for five varieties used in the district are shown in Table 8.

TABLE 8.—VARIETY TEST OF BARLEY

Dry Land

8-Year Average

Variety	Days to Mature	Length of Straw	Strength of Straw	Yield per Acre
		ins.	score*	bus.
Trebi	97	31	9	57·7
Newal	97	35	9	56·3
Sanalta	104	35	9	50·8
O.A.C. 21	97	37	8	41·7
Olli	93	32	8	40·0

* 10 indicates perfect score for strength.

The data show that Trebi has given the highest yields, followed closely by Newal. This latter variety is smooth-awned whereas Trebi is rough-awned and for that reason Newal is preferred when the straw is used for livestock. The other three varieties are relatively low yielders. Olli, because of its earliness, is useful for combating weeds.

Flax

The western side of the district, where rainfall is greater, is a more dependable area for flax than the drier, eastern side. Many good fields of flax are grown in that area each year. Bison, Royal, and Redwing have been the chief varieties grown, but there are some newer selections, now in the process of development, that appear promising.

In the variety tests the average yields of these three varieties for a ten-year period have been: Royal 13·0 bushels, Bison 12·1 bushels, and Redwing 9·8 bushels.

Irrigated Land

Hard spring wheat has continued to be an important crop under irrigation although the only advantage over grain growing on dry land is a more uniform production from year to year. A disadvantage is that irrigated wheat usually is of poorer quality due to lower protein content so in selecting hard wheat for irrigated farms those varieties that retain a high protein content are preferred.

Because of the tendency for hard wheats to have reduced protein content under irrigation, it appeared feasible to grow soft wheats for pastry and biscuit flour as these wheats previously were imported into Western Canada. Experiments have shown that this is feasible and the growing of soft wheat under contract to milling companies has become widespread. Coarse grain has been in short supply in the irrigated areas for some years due to extensive livestock feeding so these crops find a definite place on irrigated farms.

Hard Spring Wheat

Variety tests of hard spring wheat have been conducted annually under irrigation and usually about twenty varieties have been included. New varieties and strains that appeared to show any promise have been included as soon as they were introduced. The five varieties shown in Table 9 are the most important ones grown on irrigated land.

TABLE 9.—VARIETY TEST OF HARD SPRING WHEAT

Irrigated Land

9-Year Average

Variety	Days to Mature	Length of Straw	Strength of Straw	Yield per Acre
		ins.	score*	bus.
Reliance	118	44	7	70·5
Thatcher	115	43	8	65·0
Canus	118	45	9	64·7
Red Bobs 222	113	45	8	61·1
Marquis	118	47	8	60·0

* 10 indicates perfect score for strength.

Reliance has been a consistently high yielding variety on irrigated land. It is slightly weaker in the straw than Marquis or Canus, but it is considerably less subject to shattering than Canus. Thatcher is gaining in popularity under irrigation on account of its earlier maturity, shorter straw, and high yielding capacity, but its strong tendency to bleach is a decided disadvantage. Canus is very subject to shattering and is not popular on that account. Red Bobs 222 can be criticized for the same reason and for bleaching. Even though Marquis has been outyielded by the other four varieties it probably still is the best to use where the crop is likely to be subjected to weather hazards before it is harvested.

Soft Spring Wheat

There is a market for soft spring wheat in Western Canada for pastry flour and as it can be grown successfully on irrigated land, variety tests have been conducted for many years with a view to finding the most suitable variety. This test usually has included from fifteen to twenty varieties, most of which have been introduced from the United States or other countries, and many of them have been discarded on account of their habit of growth after one season's trial. A comparison of the two leading soft wheats with Dicklow, which was the standard soft wheat variety, and with Marquis for a three-year period may be seen in Table 10.

Since Lemhi, commonly grown in the United States, has been imported into Canada in considerable quantities it has become the one chosen by the milling companies for reproduction. Foundation seed of it has been procured from the Experiment Station at Moscow, Idaho, and the Lethbridge Station will aim to produce Foundation seed for Canada.

TABLE 10.—VARIETY TEST OF SOFT SPRING WHEAT

Irrigated Land

3-Year Average

Variety	Days to Mature	Length of Straw	Strength of Straw	Yield per Acre
		ins.	score*	bus.
Lemhi	126	45	7	75·6
Federation × Dicklow	125	46	7	73·6
Dicklow	137	47	3	63·5
Marquis E32	122	47	7	52·2

* 10 indicates perfect score for strength.

It will be seen from the data in Table 10 that the better varieties of soft wheat can be expected to outyield Marquis by a considerable margin.

Winter Wheat

An effort is being made to obtain a better variety of soft winter wheat for irrigated land to meet the demand for pastry flour. Varieties and strains that have shown any promise in that direction have been included in the tests for several years. The one that has given best results to date is an O.A.C. 21 selection from Dawson's Golden Chaff. Over a nine-year period it has given an average yield of 66 bushels per acre, while Kharkov M.C. 22, a hard winter wheat, under the same conditions, yielded 67·5 bushels per acre. A variety known as Cornell No. 595 and a few other selections, that have been grown only for the last three seasons, have performed sufficiently well to indicate that a superior variety may be selected from them in the near future.

Oats

Victory has been the recommended variety of oats for southern Alberta for many years but new varieties have appeared and have been put on test. Table 11 shows the average results for six varieties for a four-year period.

TABLE 11.—VARIETY TEST OF OATS

Irrigated Land

4-Year Average

Variety	Days to Mature	Length of Straw	Strength of Straw	Yield per Acre
		ins.	score*	bus.
Exeter	104	44	8	105·8
Victory	105	48	9	104·9
Beaver	102	43	10	103·3
Legacy	102	43	9	99·8
Ajax	101	44	9	91·2
Larain	100	44	9	89·7

* 10 indicates perfect score for strength.

Barley

Several new varieties of barley have been developed in the past decade as varieties in common use have been rather deficient in certain respects. Trebi for many years has been a decidedly better yielder than others tested, but unfortunately it is quite weak in the straw.

Table 12 shows the average results for a three-year period of six varieties, all of which, with the exception of Brandon No. 1356, are grown fairly commonly throughout southern Alberta.

TABLE 12.—VARIETY TEST OF BARLEY

Irrigated Land

3-Year Average

Variety	Days to Mature	Length of Straw	Strength of Straw	Yield per Acre
		ins.	score*	bus.
Trebi	99	38	5	97·3
Sanalta	105	45	6	94·4
Brandon No. 1356	100	42	6	93·1
Newal	99	42	5	84·4
O.A.C. 21	98	43	5	77·6
Olli	94	39	5	74·4

* 10 indicates perfect score for strength.

Sanalta, a two-rowed variety is quite useful under certain conditions. It is one of the best varieties in straw strength but unfortunately is considerably later than other varieties in ripening. The selection designated Brandon No. 1356 is a smooth-awned, six-rowed type that has been giving good results. It is quite similar in appearance to Newal and eventually may prove superior to it on account of the fact that Newal is quite subject to loose smut. O.A.C. 21 is still the variety preferred by the malsters but it has been a relatively low yielder, and heavy losses frequently are experienced as a result of the heads breaking off. Olli is an exceptionally early variety of barley and where there is a need to combat weeds by spring cultivation and late seeding of barley the Olli variety proves very useful.

Trebi has been grown at the Station for elite seed production, most of which has been distributed throughout the district.

Flax

Since flax is a poor crop to combat weeds it usually follows sugar beets or other hoed crops when it is grown on irrigated land. Summerfallow land is also excellent and is frequently used for flax in the few cases where summerfallowing is practised under irrigation. The variety tests of flax which have been conducted for many years have followed field beans. Data in Table 13 show the yield and length of growing period for the three standard varieties tested for a ten-year period.

TABLE 13.—VARIETY TEST OF FLAX

Irrigated Land

10-Year Average

Variety	Days to Mature	Yield per Acre
		bus.
Royal	115	31·8
Bison	111	28·5
Redwing	110	25·5

A few new and promising varieties have appeared to be equally as good as these standard varieties during the short period that they have been on test.

Bison is grown more widely throughout the district than Royal, but Royal has been a consistently better yielder. Its chief disadvantage, which makes it less popular, is its lateness and uneven maturity. It is considerably more difficult to harvest on that account.

Fibre-Flax Seed Production

The scarcity of fibre-flax seed during the war caused the Cereal Division of the Station to encourage the formation of a fibre-flax seed growers organization to undertake its production on irrigated lands of the district. Stormont Gossamer variety was grown for three years but later Liral Monarch and Liral Prince were in more demand.

All seed marketed was good quality Certified No. 1 and yields were satisfactory.

The straw was made into upholstering two and sold at $50.00 to $70.00 per ton f.o.b. shipping point.

Seed Peas

In order to determine the yielding capacity and general usefulness of the varieties of seed peas grown in the district a variety test has been conducted annually. The tests have been conducted on land that was in grain the preceding year. Seeding has been as early as possible in the spring. The results are shown in Table 14.

TABLE 14.—VARIETY TEST OF SEED PEAS

Irrigated Land

6-Year Average

Variety	Days to Mature	Length of Vine	Length of Pod	Yield per Acre
		ins.	ins.	bus.
Mackay (field)	113	42	2	35·9
Farrow's M'fat (boiling)	110	32	3	31·2
Johnston's M'fat (boiling)	109	30	3	31·2
Blue Bell (boiling)	112	31	2	29·7
Green Wrinkled (boiling)	110	42	2	28·8
Idabell (boiling)	109	28	2	28·2
Lincoln (garden)	107	25	3	25·9
Grass Pea (boiling)	113	32	1	25·3
Early Blue (field or boiling)	103	26	2	25·1
Alaska (canning or boiling)	102	34	2	21·4

As shown in Table 14, the varieties of peas of the field and boiling types tend to be heavier in yielding capacity than those of the garden and canning types. They usually also produce a little more vine growth.

Mackay, a yellow-seeded type, is one of the best varieties of field peas tested. All of those designated as boiling peas are green-seeded varieties. Lincoln is the most popular variety of garden peas in the district at present. Alaska is the earliest maturing variety in the test but it has been a consistently low yielder. It is used extensively in canning, probably not so much on account of its quality as the fact that its earliness permits the advancement of the canning season.

Field Beans

The interest taken in field beans declined throughout the war years chiefly on account of high grain prices and the difficulty in securing labour for hoed crops. Beans can be grown to advantage on farms where sugar beets are produced since the same drill and cultivator can be used for both crops, and neither seeding nor harvesting of the two occur at the same time.

Table 15 shows the average results of the variety test of field beans for a seven-year period.

TABLE 15.—VARIETY TEST OF FIELD BEANS

Irrigated Land

7-Year Average

Variety	Days to Mature	Length of Vine	Length of Pod	Yield per Acre
		ins.	ins.	bus.
Red Mexican	119	19	3	59·5
Gt. Northern No. 5	118	23	4	55·6
Gt. Northern No. 8	116	26	4	54·5
Hidatsa	115	24	4	46·8
847-2084	120	22	4	46·4
Robust	118	18	3	45·1
Lady Washington	118	22	4	44·7
Luther Burbank	114	17	3	42·9
Michelite	116	17	3	40·5
Bayo	114	20	4	40·2
Que. Red Speckled	118	15	4	39·6
Yellow Eye	114	20	4	37·7
Stringless Green Pod	118	16	4	30·6

The two strains of Great Northern, designated as No. 5 and No. 8, were selected chiefly for earliness and uniform habit of growth. These have always been good yielding strains, definitely earlier than the ordinary Great Northern variety, and generally they are fairly free from disease. Red Mexican and Hidatsa are two medium-sized, red-coloured varieties and are the most desirable of this class. Luther Burbank has been recommended for a long time as the best variety of beans of the small, white type for southern Alberta and there is no reason for changing this recommendation. The variety was made eligible for registration by the Canadian Seed Growers Association several years ago and pure seed stocks have been maintained by this Station for distribution, generally as registered seed.

HORTICULTURE

Great strides have been made in the development of the vegetable canning industry and in market-gardening in southern Alberta during the past ten years. The Division of Horticulture has played an important role in the building of these industries, aiding the canners and growers of canning vegetables and encouraging the market-gardeners. As the irrigated areas of southern Alberta expand and the need for more special crops develops, horticulture will become increasingly important in the general farming program. There is a demand for more information and for additional horticultural crops.

Breeding, variety testing, and cultural experiments are the main projects with vegetables at the Station. Cultural experiments for the control of chlorosis in small fruits and tree fruits, the development of some seedlings, and the testing of new varieties of fruits make up the work in this phase of horticulture. Varietal tests with flowers (perennials and annuals) and with shade and ornamental trees and shrubs complete the general picture of the horticultural work at the station.

Breeding

Tomatoes

Tomatoes are an important product to the market-gardener and to the canning industry. The development of a canning tomato, adapted to the climatic and soil conditions of southern Alberta, would be of great value to

farmers and canneries alike. Because of this, research in developing such a tomato has assumed major proportions. In the search for suitable types it was discovered that bush-type tomatoes held the most promise as they mature quickly and can produce a large proportion of ripe fruit during the relatively short frost-free period characteristic of the area.

Self-pruning or bush-type tomato varieties were grown for the first time at this Station in 1939. Since then much progress has been made in improving these types. One phase of this work has been a breeding program that was started in 1939 by crossing Farthest North and Polar Circle. Out of this cross a progeny was selected that had fruit at least four times the size of Farthest North and still had the earliness of this variety. This seedling was numbered L-3700. Additional selections have since been made and at present there are three promising selections of this cross.

Data presented in Table 16 indicate some of the characteristics of these selections, and an illustration showing L-3700 appears in Plate VII.

TABLE 16.—COMPARISON OF THREE L-3700 SELECTIONS

Planted out on June 4, 1946

Selection	Date 1st Ripe Fruit	Fruit Size inches	Fruit Smoothness*
L-3700 Sel. 1	Aug. 7	1·8 x 1·6	6·0
L-3700 Sel. 2	Aug. 13	2·4 x 2·0	7·5
L-3700 Sel. 3	Aug. 23	2·6 x 2·6	8·5

* A score of ten indicates perfection.

Selection No. 1 is a very prolific tomato and although it is rough and lacks finish, over a period of years it has had a short growing period of about 55 days. Selection No. 2 is about a week later than No. 1 but is much smoother and larger. The outstanding selection is No. 3. It also is the latest to ripen its fruit, and during 1946 had a growing period of about 80 days. This tomato has fruit about two and one-half to three inches in diameter, almost spherical in shape, and uniformly smooth.

These three selections of L-3700 are very useful to southern Alberta market-gardeners, especially No. 2 and No. 3. For the canning industry these selections need more colour. Breeding work is being continued in an attempt to develop a suitable canning tomato.

Sweet Corn

A breeding project is under way in an endeavour to obtain hybrid sweet corn producing early, fourteen- to sixteen-rowed, high quality, uniformly coloured, golden-eared corn by crossing corn varieties with known desirable qualities. One cross of Sunshine by Burbank's Golden Bantam, made at the Station, gave a very vigorous hybrid with desirable charcateristics. This experiment is still in progress with other varieties entering into the crosses. No attempt has been made yet to produce seed commercially.

Vegetable Seed

A phase of horticulture that is gaining in size and importance is vegetable seed production. In order to keep this phase of the industry growing and up to the high standards that are required of it, a number of experimental institutions across Canada have been given assignments to bring certain vegetable

varieties and strains up to Foundation standard. The assignment of this Station consists of: tomato—Early Chatham, cabbage—Enkhuisen, peas—Perfection, beans—Blue Lake, onion—Southport Yellow Globe. Progress has been made in this work and soon seeds of these varieties will be ready to be classed as Foundation standard.

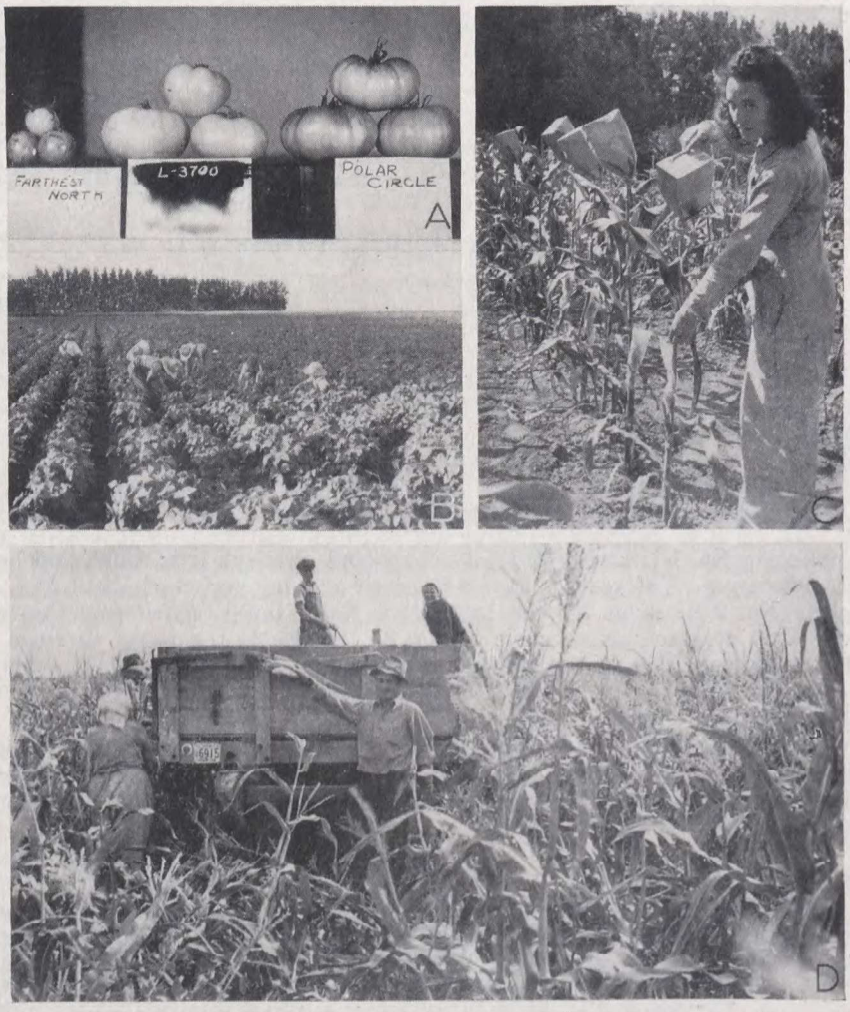


PLATE VII—PHASES OF HORTICULTURAL ACTIVITIES IN SOUTHERN ALBERTA.

A. (Centre) New tomato variety known as L-3700 bred at the Lethbridge Station. Outstanding strains have been selected from this variety which was produced by crossing Farthest North (left) and Polar Circle (right).

B. Harvesting a commercial crop of bush beans.

C. Corn breeding.

D. Harvesting a crop of sweet corn for canning.

Variety Testing

Vegetables

Variety testing of vegetables and fruits is an important part of the horticultural work. Certain vegetables are used as standards because they have been proved satisfactory and new introduced varieties and strains are compared with them. The object of this variety testing is to discover better vegetable varieties for canning, for the market-gardener, and for the home-gardener.

The following is a list of vegetable varieties recommended for southern Alberta, based on experiments conducted during the ten years, 1937-46.

Beans	Round Pod Kidney Wax, Tendergreen*, Blue Lake (Pole Bean)*
Cabbage	Golden Acre (early), Copenhagen Market (medium) Danish Ballhead (late, storage).
Celery	Golden Self Blanching (early), Utah or Salt Lake (late and green).
Carrots	Nantes (early), Chantenay (late, storage), Imperator (bunching).
Cauliflower	Snowball* (early), Snowdrift (late).
Corn	Golden Early Market (early), Marcross*. (midseason), Golden Bantam* (late).
Cucumbers	Early Russian (pickling), Delcrow (slicing).
Eggplant	Blackie
Lettuce	New York No. 12 (head), Grand Rapids (leaf).
Muskmelon	Farnorth, Chipman's Champlain.
Onions	Southport Yellow Globe (late, storage), White Barletta (pickling).
Parsley	Paramount.
Parsnip	Hollow Crown (storage).
Peas	Little Marvel* (early), Lincoln* (mid-season), Stratagem* (late).
Peppers	Harris Earliest*
Potatoes	Irish Cobbler (early, storage), Netted Gem (late, storage).
Pumpkin	Small Sugar.
Radish	Saxa (red), Icicle (white).
Rhubarb	Macdonald*, Ruby.
Spinach	Bloomsdale (wrinkled or savoy leaf), King of Denmark (non-wrinkled or smooth leaf).
Squash	Golden Hubbard (summer), Buttercup (winter, small, storage), Green Hubbard* (winter, large).
Tomatoes	Selections of L-3700, Early Chatham, Bounty (bush or self-pruning) Earliana, Bonny Best, (pruning and staking).
Turnip	Laurentian.
Vegetable Marrow	Cocozelle (late storage).
Watermelon	Early Canada, Sweet, Sensation.

* Suitable for freezing.

Taber Substation.—Horticultural experimental plots were established in 1946 at Taber, Alta., for the purpose of testing vegetable crops in that area. Though Taber is only 30 miles from the Lethbridge Station, soil and climatic conditions are such that certain crops can be grown more successfully there than at Lethbridge.

Light and medium loam soil predominates in the Taber area, whereas the heavier silt and clay loam soils predominate at Lethbridge. As indicated by

the data in Table 17, the summer temperatures are higher at Taber than at Lethbridge and this encourages the production of such hot-season crops as melons, peppers, and eggplants.

TABLE 17.—COMPARISON OF SUMMER TEMPERATURES AT LETHBRIDGE AND TABER 1946

Month	Max. Temp.		Mean Max. Temp.		Min. Temp.		Mean Min. Temp.	
	Leth-bridge	Taber	Leth-bridge	Taber	Leth-bridge	Taber	Leth-bridge	Taber
May	82·0	89·0	63·4	65·8	16·0	20·0	36·0	37·0
June	83·0	87·0	69·1	72·3	35·5	30·0	44·5	43·2
July	95·0	100·0	81·3	85·5	38·5	37·0	50·7	49·2
August	93·0	102·0	76·5	81·0	33·0	33·0	47·2	44·7
September	82·5	90·0	65·8	72·2	25·0	22·0	42·2	39·9

An indication of the effect of the differences in summer temperatures at Taber and Lethbridge is provided by the data in Tables 18 and 19 which show the comparable yields of tomatoes and corn at the two locations in 1946. It is emphasized that the yields given in Tables 18 and 19 are for the year 1946 only.

TABLE 18.—COMPARISON OF TOMATO VARIETIES GROWN AT LETHBRIDGE AND TABER 1946

Variety	Source	Ready to Use		Yield per 30-ft. row	
		Taber*	Lethbridge**	Taber	Lethbridge
				lb.	lb.
N.D.A.C. No. 38	L.E.S.	Aug. 13	Aug. 30	30·1	7·0
John Baer Geneva	Brooks	Aug. 30	Sept. 16	14·4	Nil
Early Chatham	M.E.S.	Aug. 13	Aug. 24	45·5	50·4

* Transplanted June 4.
** Transplanted June 11.

TABLE 19.—COMPARISON OF CORN VARIETIES GROWN AT LETHBRIDGE AND TABER 1946

Variety*	Source	Ready to Use		Yield per 30-ft. row	
		Taber	Lethbridge	Taber	Lethbridge
				lb.	lb.
Seneca Dawn	D.F.	Aug. 13	Aug. 20	81·4	113·5
Spancross	D.F.	Aug. 7	Aug. 15	36·2	18·5
Dorinny	D.F.	Aug. 7	Aug. 15	20·2	20·4

* Seeded May 17.

The data in Tables 18 and 19 indicate variety differences in reaction to the conditions in 1946 at the two locations. No yield is shown for John Baer Geneva tomato because the first ripe fruit occurred after the first killing frost of September 10, 1946, and no yields were recorded after that date. John Baer was included in this table to show the relative lateness of this variety, an indeterminate variety, compared with the other two (determinate) varieties in this area. The L-3700 selections were not shown as they were not included in the same test with the named varieties.

Small Fruits

Although it is at present only on a limited basis that small fruits are grown commercially on irrigated land, small fruit growing is a potentially big industry under irrigation. Therefore, varieties of small fruits such as raspberries, strawberries, currants, and gooseberries are tested extensively at this Station.

Five new raspberry varieties, that originated in Ottawa, have been under test for several years. They are Madawaska, Gatineau, Ottawa, Trent, and Rideau. These have done very well under irrigation conditions and two, Ottawa and Rideau, show promise for this area. These varieties, as well as all other raspberry varieties, must be covered for winter protection in the Lethbridge area.

Rust-resistant black currants have been under test for three years and to date have shown no rust infection nor any sign of rust. They are doing exceptionally well in this area.

The past ten years' tests with small fruits would warrant recommending the following varieties.

Strawberry	British Sovereign (June bearer), Gem (everbearing).
Raspberry	Newburgh, Herbert, Ottawa, Rideau.
Red Currants	New Red Dutch.
Black Currants	Early Topsy.
White Currants	White Dutch.
Gooseberry	Pixwell, Champion.

Tree Fruits

A new test orchard of tree fruits and nuts, including in all 199 varieties, was established in 1939. The plantings consisted of: plums, cherries, cherry-plum hybrids, apricots, black walnuts, horse-chestnuts, butternuts, pears (seedling and standard), apples (seedling and standard), and crabapple and crabapple hybrids.

Cultural Experiments

Fertilizers

Fertilizer experiments with tomatoes and celery have shown that inorganic fertilizers have not caused significant increases in yield or early maturity.

With potatoes the results have been somewhat different. A fertilizer test was set up in 1946 where eight fertilizer combinations were used, i.e., 9-27-9, 8-10-5, 11-48-0, 2-16-6, 8-32-4, 4-12-8, 0-38-0, 2-19-0 together with a check plot which received no fertilizers.

The results of this experiment are summarized in Table 20.

TABLE 20.—SUMMARY OF MEAN YIELDS OF POTATOES TREATED WITH EIGHT FERTILIZER COMBINATIONS

Fertilizer	Mean Yields in lb. per 50-ft. row
9-27-9	67·6**
8-10-5	62·2
11-48-0	71·7**
2-16-6	60·5
8-32-4	72·7**
4-12-8	60·2
0-38-0	62·9
2-19-0	64·5**
Check	54·5

** Highly significant increases over check.

The data show that in all cases the yields from fertilizer treatment were higher than when no fertilizer was applied. However, the yields were sufficiently greater to be significant in only four treatments. All four of these fertilizers were high in phosphorus, which is in agreement with other experiments, and indicates that the soils in this area are deficient in available phosphorus. The data indicate that when nitrogen was added to the phosphorus additional benefit was derived.

Strawberry Chlorosis

One of the hazards of commercial strawberry production is chlorosis, a type of yellowing of the leaves caused by a soil deficiency. The following results are from an experiment carried on to study the control of chlorosis. Iron sulphate and ammonium sulphate when used alone or in combination seem to be ineffective in the control of chlorosis in strawberry plants when sprayed on the leaves in liquid form. Ammoniated iron citrate seemed to control chlorosis in strawberry plants without injury to the foliage and left the plants in a vigorous growing condition.

Chlorosis Among Tree Fruits

Chlorosis, a "yellows" caused by a soil deficiency and aggravated under irrigated conditions, has become very widespread among the tree fruits on the station. Plums show the greatest susceptibility. The variety Dropmore Blue, is particularly susceptible. There also is a considerable showing of chlorosis on some apple and crabapple trees in the new test orchard. In the other orchards, chlorosis is almost as severe with the apples as with the plums.

An experiment was run for six years to determine the cause and establish a control for chlorosis. Results obtained were variable although certain treatments were quite successful. The use of iron compounds, either in the dry state or in solution, applied to the soil, gave negative results in all cases. Direct injection of the iron compounds into the tree trunks gave excellent results in practically all cases except when excessive amounts were used and the foliage was burned severely. The best results were obtained by spraying the trees or plants with an iron solution. The use of flour or skim-milk in the solution helped to spread the solution on smooth or glossy foliage.

Fire-Blight

Another trouble occurred in the new test orchard in 1940 when fire-blight, a bacterial disease, became prevalent.

Fire-blight severely attacked the majority of the apple and crabapple trees growing in this orchard and spread to all the station orchards. It was thought that the disease came from infected nursery stock brought in for breeding work. The resulting attacks of this disease have destroyed one orchard and left great bare places in all the other orchards not to mention the many distorted trees that are still left standing though badly damaged. Few varieties are resistant and it seems that none are immune. The more tender succulent growth seems to be the first to be infected on the trees. The only measure of control on this station, other than growing resistant varieties of apples, has been to cut out the diseased wood during the dormant season and disinfect the cut ends of the branches. Any removal of diseased wood during the growing season only increases the spread of the disease.

The following varieties have shown nearly complete resistance to fire-blight under Lethbridge conditions. In some years the succulent wood even on these have shown traces of the disease.

Apples	Haralson, Heyer No. 12, Hibernal, Manitoba Spy, Moscow Pear, Red Duchess, and Dr. Bill.
Apple by crabapple hybrids	Rescue, Trail, and Wapella.
Crabapples	Columbia, Dolgo, Florence, and Sylvia.

FORAGE CROPS

The work with forage crops naturally divides itself into two major phases, namely, dry land forages and irrigated forage production. The two are concerned with improving both the quantity and quality of livestock feed and with fitting into a pattern of proper land use and conservation in a balanced agricultural program.

Regrassing Abandoned Farm Land

During the past three decades a combination of periods of drought and poor soil has forced the abandonment for grain production of millions of acres of once cultivated land in southern Alberta. This has brought with it many problems of social rehabilitation but primarily it has developed into a problem of getting the abandoned and waste land back into productive use in an integrated, sound, land-use program.

With the enactment of the Prairie Farm Rehabilitation Act in 1935 means were provided for the Lethbridge Experimental Station to undertake work in connection with this major problem. In co-operation with the Special Areas Board (a provincial administrative unit organized to administer the worst affected areas) and municipalities, seven regrassing stations were set up to study means of returning abandoned farm land to productive use. The seven stations were selected to include the major soil variations and weed population types encountered in the area.

The purpose of these stations was to determine the feasibility of rapidly getting the abandoned areas into grass production. The program included studies of cultural practices and species of forage crops suitable for this purpose. Previous knowledge indicated crested wheat grass, brome grass, and slender wheat grass to be the most promising species and these were put under test. At the same time experiments were included on rates, spacings, times, and methods of seeding. Plots ranged in size from 3 to 15 acres. Results, on the basis of stands obtained and changes in vegetation, were studied by means of pantograph chart quadrats, basal area estimates, hay and seed yields, and by general observations.

Species Tests

The results of the test of the three species, crested wheat grass, brome grass, and slender wheat grass, at all seven stations were very similar, so data from the Bowell Station, which were typical, will be used as the main basis for discussion. The data of the basal area study are presented graphically in Figure 1.

It will be noted that there was very little difference in the basal area of the three grasses during the first season. This changed by the second season when crested wheat grass was superior and in the third season the crested wheat grass continued to increase while the basal area of slender wheat grass and brome grass began to decrease. Statistical analysis of the data showed that the difference between species were highly significant. A good conception of the desirable thickness of crested wheat grass stands, in the terms of basal area, may be obtained

from results at Naco where it was shown that a stand with a basal area of 14 per cent produced more hay and seed than a stand with a basal area of 30 per cent. In general, a stand of this grass with a basal area ranging from 15 per cent to 23 per cent appeared very good under the conditions of this investigation.

Data from the frequency-number quadrats and basal-area estimations were obtained. With only one exception crested wheat grass was superior to slender wheat grass and brome in frequency, average number of seed stems, average number of plants, and basal area in the third, fourth, and fifth season of growth.

Another superior characteristic of crested wheat grass is that it has been much easier to obtain stands of this grass than of the other two species. Difficulty was experienced in getting stands of slender wheat grass and brome at Cessford in 1935 and 1937, at Stanmore in 1936, and at Sullivan Lake in 1936 and 1937. Crested wheat grass was the only one to survive a dry season immediately following seeding. This does not mean that fully established stands of slender wheat grass or brome will succumb to one or two dry seasons. During dry years these grasses produce very little forage but make a fair recovery in moist seasons. The productive ability of brome grass is unpredictable and the results of the regrassing

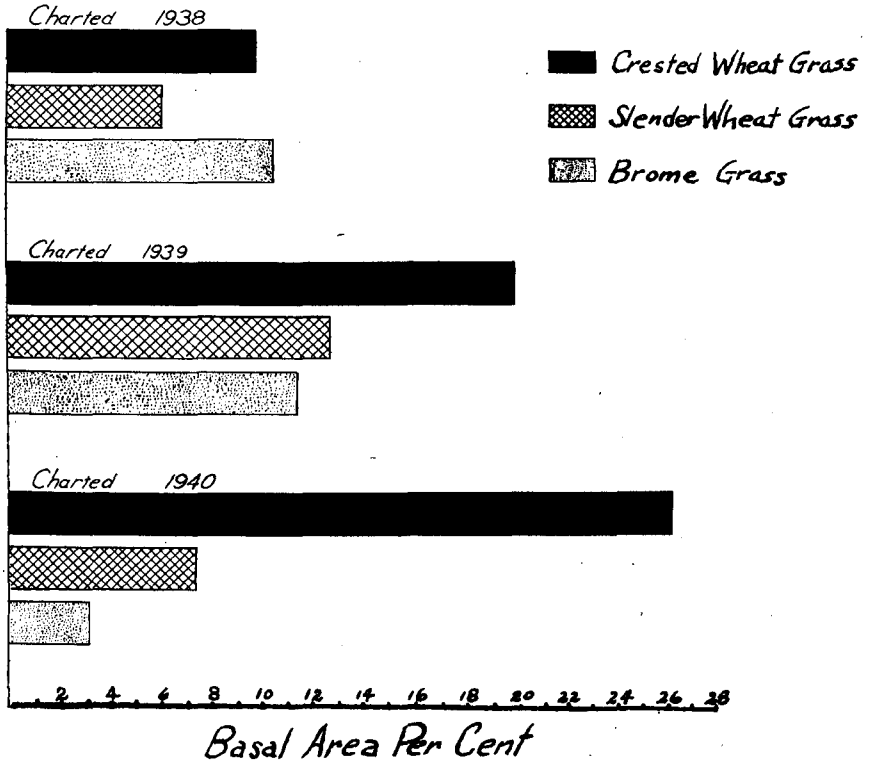
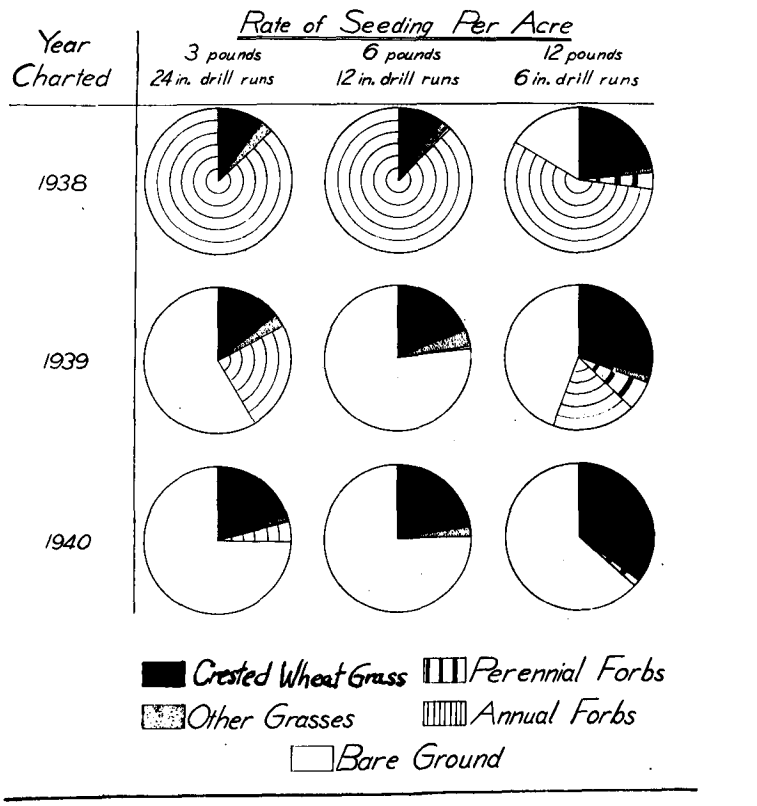


FIG. 1—Basal area of crested wheat grass, slender wheat grass, and brome grass at the Bowell Regrassing Station.

experiments lead to the conclusion that, in general, neither slender wheat grass nor brome are suitable forage or pasture crops over most of the "special areas", except on the northern fringe, while crested wheat grass is especially suitable.

Rates of Seeding Crested Wheat Grass

Plots were seeded to crested wheat grass at rates of 3, 6, and 12 pounds per acre to determine the most desirable seeding rate. The results obtained are shown graphically in Figure 2.



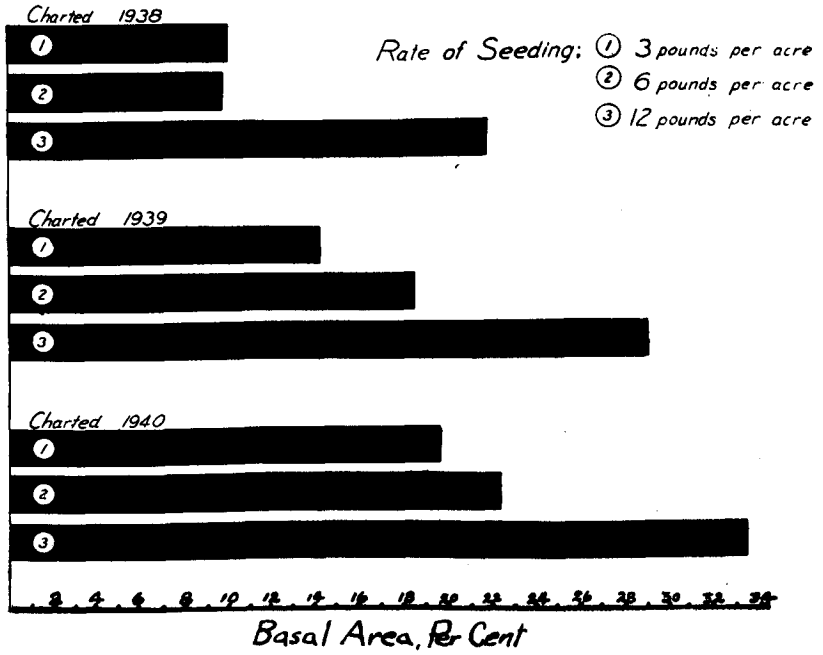


FIG. 2—Basal area of crested wheat grass from three rates of seeding.

It will be seen that in all cases, as the stands age, the basal area of crested wheat grass increases steadily while the basal area of all other vegetation decreases. This is shown clearly in the ratio of crested wheat grass to all other vegetation. In other words, the crested wheat grass became thicker and crowded out the weeds and other vegetation.

Hay and seed yields for different rates of seeding at a number of Stations are presented in Table 21.

TABLE 21.—AVERAGE YIELDS OF CURED HAY AND SEED IN 1940 ON PLOTS SEEDED TO CRESTED WHEAT GRASS AT 3, 6, AND 12 POUNDS PER ACRE

Station and Time of Seeding	3 pounds		6 pounds		12 pounds	
	Hay	Seed	Hay	Seed	Hay	Seed
	Tons per Acre	Lb. per Acre	Tons per Acre	Lb. per Acre	Tons per Acre	Lb. per Acre
Cessford: Late Fall 1935....	1·80	348·0	1·25	228·0	1·20	92·7
Cessford: Spring 1936.....	1·82	193·3	1·62	183·6	1·32	179·0
Bowell: Late Fall 1937.....	1·19	N.D.*	0·88	N.D.*	0·86	N.D.*
Naco: Late Fall 1937.....	2·08	381·9	1·81	249·4	1·59	82·0

* No data.

The most suitable rate of seeding for general use in the regrassing of abandoned lands in the dry areas of Alberta seems to be six pounds per acre.

Time of Seeding

In the regrassing experiments, time of seeding tests with crested wheat grass were made on all stations. The results obtained are shown graphically in Figure 3.

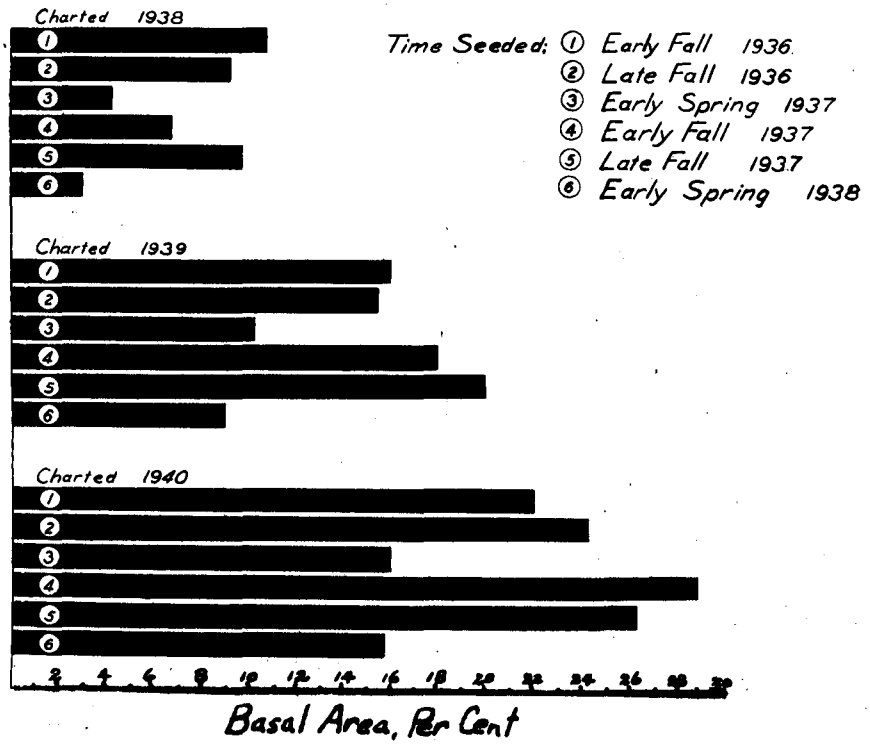


FIG. 3—Basal areas of crested wheat grass from various dates of seeding.

Differences between time of seeding and between years were highly significant. The choice between early and late fall seeding depends almost entirely upon local conditions. Early fall seeding has been very successful where the seeding was done at the time of favourable moisture conditions. Seldom has there been insufficient moisture to start early fall growth. However, occasionally early fall seedings have not germinated until late in the fall or the following spring because of absence of moisture in the surface soil. Early fall seeding is extremely hazardous where grasshopper infestations are severe and many stands of young crested wheat grass have been severely damaged in the seedling stage by this insect.

Methods of Seeding Crested Wheat Grass

Comparisons of drilling and broadcasting and methods of broadcasting were conducted on all the regrassing stations.

During the study the following facts were noted: drilling the seed directly into competitive weed vegetation has resulted in excellent stands of crested wheat grass; broadcasting into the same cover has seldom resulted in good stands; and broadcasting followed by a cultivation has produced stands about as good as those obtained by drilling. From this it follows that the essential feature in any method of seeding is that the seed be covered by a thin layer of soil. Drilling has been the most satisfactory method. Broadcasting accompanied by a cultivation was second best but involved twice as much labour and the covering of the seed was not so uniform.

Competition Studies

The results of the regrassing studies indicate that, in general, crested wheat grass may be expected to reclaim abandoned lands made up of medium heavy to light soils and to a large extent it will control the vegetation existing on such lands. It does not compete so well on heavy soils and cannot be expected to replace species suited to heavy clay soils.

Hay Production

Development of winter feed reserves is an important factor in grass utilization. Proper stacking of hay is essential to the development of these reserves, so demonstration of the practicability of building large, long-lasting stacks of hay was an integral part of the regrassing work. For this purpose inexpensive single-pole stackers were constructed on some of the regrassing stations. A comparison of a large stack, constructed with such a stacker, and a small stack is shown in Plate VIII. (Refer p. 81).

It is evident that the loss from weathering is much less in the large stack than in the small stack.

Crested Wheat Grass Grazing Project

The ultimate object of the regrassing work was to return abandoned land to economical production. As forage can be utilized only by livestock the suitability of the grass for livestock was very important. Many farmers and ranchers had expressed the opinion that cattle would not eat crested wheat grass and that it was not of much value to them. These facts prompted the establishment of a grazing project on crested wheat grass pasture at the Cessford regrassing station in 1942.

On June 22, 1942, ten cows with calves and ten yearlings were placed in the pasture. The cows were on the crested wheat grass pasture continuously until October, 1946. During particularly severe winters they were given crested wheat grass hay as needed and during the winter of 1942-43 some oats were used to supplement the ration. The yearlings were removed after the first year and the project carried on with cows and calves after that time.

Probably the most important fact brought out by this grazing project is that crested wheat grass can be used as the sole, year-round pasture if necessary and cattle on it will make good gains. It would, of course, be suitable to use crested wheat grass as early spring or late fall pasture in conjunction with some other type of range. This is advantageous in the case of native range since

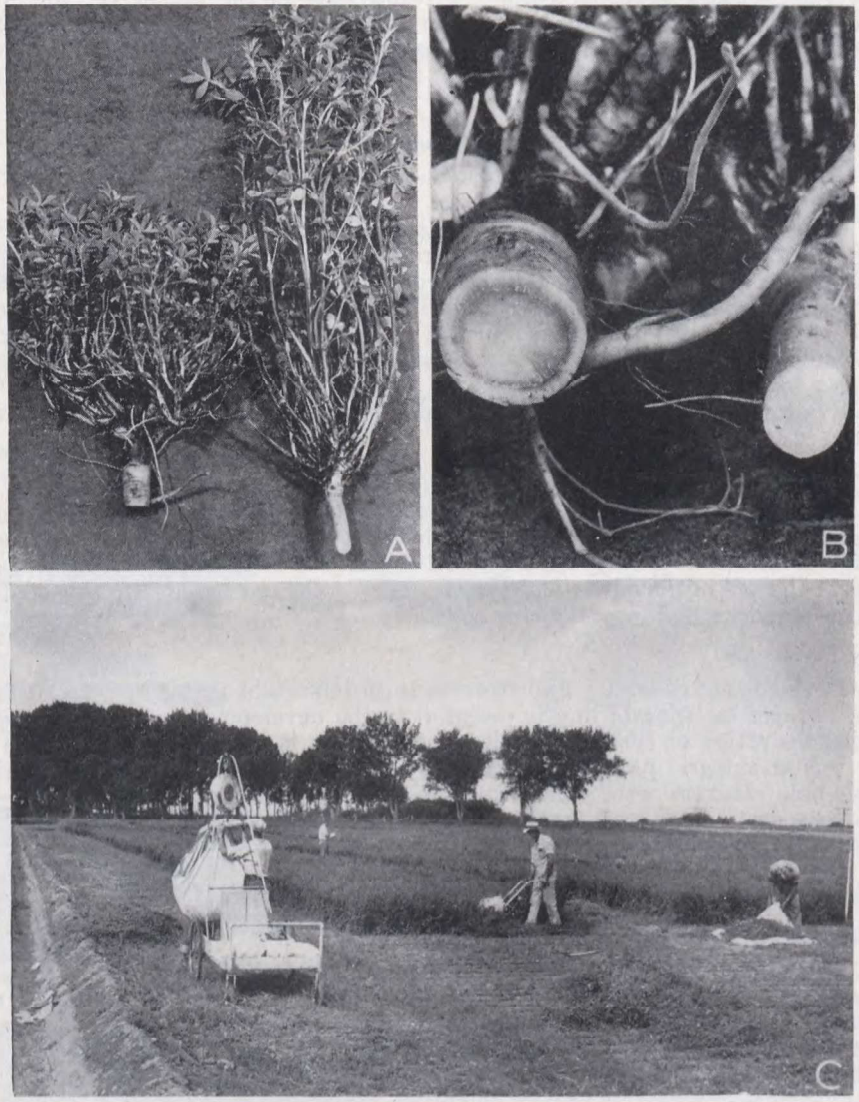


PLATE IX—STUDIES IN BACTERIAL WILT.

This disease has been found in all fields of alfalfa inspected in southern Alberta where stands are more than three years old.

A. (Left) Alfalfa plant affected by bacterial wilt.
(Right) Normal alfalfa plant.

B. (Left) Cross-section of an old alfalfa root affected by bacterial wilt. Note discoloration of the diseased tissue. (Right) Cross-section of a normal young alfalfa root.

C. Harvesting alfalfa plots at Lethbridge where hundreds of selections are being tested mainly for wilt resistance, winter hardiness, and yield.

most native grasses do not start growth until much later in the spring than crested wheat grass does and the use of the crested wheat grass would provide earlier spring pasture and at the same time conserve the native grass. Crested wheat grass also has the ability to withstand grazing and trampling very well during the early spring.

Throughout the course of this grazing trial it was obvious that the cattle preferred the thicker stands of grass rather than those containing large scattered clumps, apparently because of the finer texture of grass in the thicker stands. This bears out the recommendation that, when seeding for pasture purposes, a slightly higher rate of seeding should be used than for hay production.

Bacterial Wilt and Crown Rot in Alfalfa

Most of the work with alfalfa, during the last few years, has been confined to a co-operative project, between this Station and the Dominion Laboratory of Plant Pathology, Edmonton, on breeding for resistance to bacterial wilt and crown rot. Experimental work on this project was started in the spring of 1945 though surveys had been conducted previously.

General Survey of Irrigation Districts

In this survey some 20 fields in the Lethbridge-Coaldale area were visited and the damage caused by the disease was estimated on the following basis.

Trace—Occasional scattered plants dying or severely dwarfed
Slight—Less than 5 percent of severely diseased or dead plants
Moderate—5 to 20 per cent severely diseased or dead plants
Severe—More than 20 per cent severely diseased or dead plants

General infection in the field was confirmed by making a number of random root analyses. The general survey showed that bacterial wilt was present in every irrigated alfalfa field, three years old or older, inspected in southern Alberta.

Detailed Survey of Experimental Fields by Root Analyses

Root analyses were made by digging up the plants and grading them into the following classes after studying both the tops and the roots.

Class	Description
1	First flecks of browning in roots
2	Definite indications in roots
3	Moderate root discoloration and beginnings of top symptoms
4	Roots discolored, plants dwarfed, tops wilted
5	Dead

Age of Stand.—Comparisons of the amount of bacterial wilt in different age stands were made by analysing the roots that fell within ten randomized quarter-meter quadrats. Studies were made on stands of Grimm, 1 to 6 years old. The data collected are summarized in Table 22.

TABLE 22.—ROOT ANALYSES SHOWING PERCENTAGE OF BACTERIAL WILT IN PLOTS OF GRIMM ALFALFA FROM 1 TO 6 YEARS OLD

Age of Stand	Percentage of Plants with Bacterial Wilt					Total
	Class 1	Class 2	Class 3	Class 4	Class 5	
1 year	0·8	0·4	.....	.....	.....	1·2
2 years	0·9	.....	.....	.....	.....	0·9
3 years	16·8	4·0	0·5	.....	.....	21·3
4 years	14·8	7·4	11·3	7·8	4·3	45·6
5 years	13·8	5·6	14·8	12·1	16·7	63·0
6 years	8·6	6·7	10·5	35·2	28·6	89·5

It is clearly evident that the disease built up rapidly from the third year on. This remarkable build-up of disease caused a serious reduction of yield, a reduction that is so common in the Lethbridge and Brooks areas that many stands are being ploughed up in the fourth year.

Variety Differences.—Seven varieties were studied for both bacterial wilt and crown rot. The varieties were chosen from a variety test seeded in the spring of 1940. Large portions of the plots of each variety were dug up, the roots were taken in and washed, and then were inspected for disease. The results of this study are presented in Table 23.

TABLE 23.—ROOT ANALYSES OF ALFALFA VARIETIES FOR BACTERIAL WILT AND CROWN ROT 1945

Variety	Total No. Roots Studied	Bacterial Wilt Alone	Bacterial Wilt and Crown Rot	Crown Rot Alone	Free of All Disease	Total Plants with B. Wilt	Total Plants with C. Rot
		%	%	%	%	%	%
Viking	850	7·05	35·29	53·29	4·35	42·34	88·58
Ranger	463	4·32	16·41	70·19	9·07	20·73	86·60
Ladak	998	5·11	32·16	58·71	4·01	37·27	90·87
Autogamous	669	2·69	61·58	35·27	0·44	64·27	96·85
U.B.C.	585	9·40	77·26	12·82	0·51	86·66	90·08
Ont. Variegated	833	2·64	60·26	37·73	0·36	62·90	96·99
Grimm	1,027	1·56	81·40	16·94	0·40	82·96	98·34
	5,425						

NOTE: Crown rot prevalent in both U.B.C. and Grimm but lesioning much less developed.

Ranger, which was developed for wilt resistance, shows up very well in this respect, while both Ladak and Viking have promise. Crown rot was very prevalent in all varieties, although in Grimm, and particularly U.B.C., lesioning was much less severe.

Effect of Fertility and Bacterial Wilt on Yields

The first report of bacterial wilt in southern Alberta was in 1939 and the losses caused by this disease have become very noticeable during the last five years. Before the disease became a factor there was no marked reduction in yield due to age of stand up to six years. Figure 4 is a chart showing the average yields of alfalfa from 1936 to 1940 and 1941 to 1945, on stands from 1 to 6 years old, with and without fertilizer.

The reduction in yield for the last three years is very pronounced, especially for the fertilized fields.

Variety Test in Wilt Infested Soil

Early in the spring of 1945 an area in the centre of an old stand of severely diseased alfalfa was broken and worked a number of times to remove old roots. Into this was seeded a set of plots composed of eight varieties of alfalfa replicated four times. The varieties were: Ranger, Viking, Hardistan, Meeker Baltic, Buffalo, Cossack, Grimm, and Ladak. A very good catch of alfalfa was obtained on all plots. Irrigation water was run over the old diseased stand and on to the plots in an attempt to spread the disease more rapidly. Yield data were accompanied by a botanical analysis of the vegetation in order to evaluate the true reduction of alfalfa by wilt.

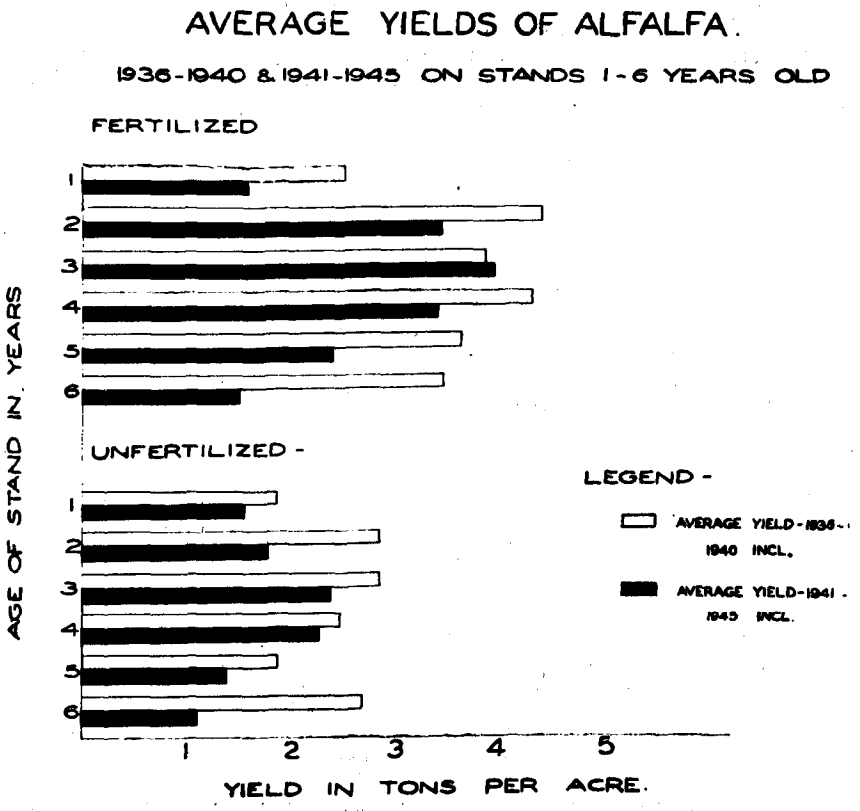


FIG. 4—Chart showing the increasing seriousness (1936—40 compared with 1941-45) of bacterial wilt in reducing yields of alfalfa.

Breeding for Resistance to Bacterial Wilt

In 1945 a co-operative project between the Lethbridge Experimental Station and the Dominion Laboratory of Plant Pathology at Edmonton was established for the purpose of developing resistance to bacterial wilt and crown rot in alfalfa. Plants free of bacterial wilt and crown rot were selected from wilt-infested plots at Lethbridge and increased by root and stem cuttings in Edmonton during the winter. These were returned to Lethbridge in May, 1946, where they were planted in wilt-infested soil after first being suspended in a bacterial inoculum. A second inoculation was given in August by needle injection. Only those plants that remain free of bacterial wilt after both inoculations will be selected for further breeding purposes.

Wilt testing is also conducted on breeding material from other Experimental Stations and Universities. Simultaneously, crown rot tests are conducted on the same material at the Dominion Laboratory of Plant Pathology, Edmonton.

MISCELLANEOUS PLANT BREEDING

Orchard Grass

Orchard grass (*Dactylus glomerata*) is one of the most productive grasses in irrigated pastures in the Lethbridge area. It has a rapid rate of recovery after cutting or grazing and is well liked by most classes of stock. The one weakness of

orchard grass in Western Canada is its lack of winter hardiness and so most of the work with this species has been directed toward the development of hardiness. Selections were made from a field of orchard grass 35 years old on the Lethbridge Station. From these selections 2,000 individuals were established in a breeding nursery. A clonal nursery of 20 clones each for 51 selections from the breeding nursery has now been established. Selected lines will be combined and tested for hardiness in areas of more severe winters.

Winter Fat

Winter fat (*Eurotia lanata*) is a particularly valuable native forage plant that is hardy and drought resistant. It is a high protein plant that retains the high protein content through the winter thus making it an important component of winter ranges.

In 1944 seed was collected for seeding trials, alone and in mixture with grasses, on dry land. In 1945 a plant nursery was established to study the variations of types. In 1946 a breeding nursery was established for the purpose of selecting suitable types for range reseeding.

Big Blue Grass

Big blue grass (*Poa ampla*) is a native grass that grows well under dry conditions. Preliminary selection has been completed to obtain uniformity and increased yields.

Korean Brome

Korean brome (*Bromus ornans*) is a non-creeping brome grass, fine leafed, and fairly drought resistant. Selections have been made for leaf type and yield. A clonal nursery of selected plants has been established.

ANIMAL HUSBANDRY

In the preparation of this section of the report it has been deemed advisable to discuss the various projects under phases of work rather than by classes of stock as the primary division. Consequently, projects will be discussed under the headings: Breeding, Nutrition, Production and Management, and Wool.

Sheep Breeding

Rambouillet Sheep Improvement

The Rambouillet breed continues to be the basic range breed although it is in need of improvement in body conformation, length of staple, face cover, and wrinkling. Continued rigid selection in the Lethbridge flock has brought about marked improvement in the three last-named characteristics but improvement in body conformation has been less successful. However, some improved individuals have been developed and further progress can be expected.

New Zealand Corriedale Sheep for Crossing

A small band of purebred New Zealand Corriedale sheep has been maintained for a number of years to provide rams for breeding experiments. This breed has desirable conformation and wool production but the Lethbridge flock is less prolific and lighter in body weight than either the Canadian Corriedale or the Rambouillet. It is doubtful that this breed has a place as a pure breed for range purposes though it can serve a useful purpose for crossing on short stapled, fine-wool ewes for improvement of these characteristics. The crossbreds also will be superior in conformation to the Rambouillets.

Some production characteristics are shown in Tables 24 and 25 with data from other breeds and crosses for comparison.

TABLE 24.—SUMMARY OF REPRODUCTIVE PERFORMANCE OF EWES 1943-46

Breed of Ewes	Breed of Sire	% Lambed	% Dry	% Aborted	Lambing percentage based on	
					Ewes Bred	Ewes Lambed
New Zealand Corriedales	New Zealand Corriedales	92·2	6·4	1·4	99·3	107·7
Canadian Corriedales	Canadian Corriedales	89·3	10·2	0·4	126·4	141·5
Rambouillet	Rambouillet	92·7	6·9	0·4	128·3	138·4
Rambouillet*	New Zealand Corriedales	93·8	3·7	2·5	137·0	146·0
C1	Canadian Corriedales	90·0	10·0	0·0	143·8	159·7
C2	Canadian Corriedales	95·0	4·1	0·9	131·4	138·3
C3	Canadian Corriedales	89·7	9·3	1·0	113·9	127·0
C4*	Canadian Corriedales	54·5	45·4	0·0	63·6	116·7

*1945—46 only.

TABLE 25.—SUMMARY OF MORTALITY AMONG LAMBS FROM BIRTH TO WEANING 1944-46

Breed of Lambs	Born Dead	Died 1st 2 Weeks	Died Birth to Weaning	Weaned
	%	%	%	%
New Zealand Corriedales	0·9	2·9	19·2	80·8
Canadian Corriedales	5·1	7·3	23·7	76·3
Rambouillet	2·3	6·2	12·1	87·9
C1	1·8	6·7	16·8	83·1
C2	4·8	8·0	18·0	82·0
C3	3·1	2·7	8·5	91·5
C4	1·0	4·0	13·2	86·8

Canadian Corriedale Sheep

In addition to work on the improvement of the Rambouillet breed an effort has been made to develop a new, improved range sheep. This development, the Canadian Corriedale, showed considerable promise while the sheep were maintained at the main Station at Lethbridge but, since they were moved to the more rigorous environment of the sheep station, certain weaknesses have become evident. Reference to Table 26 will show that the Canadian Corriedales have declined in reproductive performance whereas the Rambouillets have shown improvement.

TABLE 26.—SUMMARY OF REPRODUCTIVE PERFORMANCE OF VARIOUS BREEDS AND CROSSES OF SHEEP UNDER TWO ENVIRONMENTAL REGIMES

Breed	Per Cent of Bred Ewes That Lambed		Lambing Rate			
			% On Basis of Ewes Lambed		% on Basis of Ewes Bred	
	1934-40[1]	1944-46[2]	1934-40	1944-46	1934-40	1944-46
New Zealand Corriedales	91·3	94·5	114·0	104·8	104·1	99·1
Canadian Corriedales	91·1	87·9	146·0	140·3	133·0	123·3
Rambouillet	89·6	95·1	124·0	137·0	111·0	129·4
C1	97·4	93·8	129·7	146·0	126·3	137·0
C2	96·3	88·6	111·5	159·0	107·4	140·9

[1]1934-40 the sheep were at the main station, Lethbridge.
[2]1944-46 the sheep were at the new sheep station, Scandia.

Another important production factor summarized in Table 25 shows that the mortality of lambs is higher for Canadian Corriedales than for the Rambouillets. Part of this decline in the Canadian Corriedales may be caused by the inbreeding that has taken place in this breed and the breeding program has been changed to overcome the effects of inbreeding as much as possible.

Crosses have been developed between the Corriedales and the Rambouillets and reference to the foregoing tables indicate that these crosses are quite satisfactory.

Despite the undesirable features noted for the Canadian Corriedales they still hold some promise because of improved conformation, freedom from wrinkles, open faces, and long-stapled wool of desirable quality.

Inbreeding Affects Fleece and Body Weights

One of the effects of inbreeding often reported is a reduction of vigour and productive ability in inbred stock. In the Canadian Corriedales it has been found that both body weights and fleece weights were reduced by inbreeding. Negative correlations of —0·450 for inbreeding and body weights and —0·348 for inbreeding and fleece weights were found despite careful selection for increased body weights and fleece weights. Both these correlations are statistically highly significant and the same is true of the regression coefficients —0·752 and —0·057. From the practical standpoint this would mean that, for each one per cent increase in inbreeding, an average decrease of 0·75 pound in mature body weight and 0·05 pound in fleece weight may be expected.

Inbreeding Affects Individual Desirability

Each fall at weaning time the lambs in the flock have been culled on the basis of their individual desirability without reference to their pedigrees. Thus no bias was introduced into the selection but data became available to determine the relationship of individual desirability to degree of inbreeding. An analysis of the data showed that on the average the lambs that were culled were more highly inbred than those that were retained for breeding. This would indicate that as inbreeding is intensified the average level of desirability decreases despite selection.

A New Lethal Discovered

One effect of inbreeding is to uncover recessive gene effects by bringing the genes into homozygous condition. In the inbreeding of the Canadian Corriedales one highly undesirable characteristic was discovered. This is an abnormality of the nervous system the symptoms of which are inco-ordination, curvature of the back, reflexing of the neck, and continuous muscular activity causing a twitching and kicking of the legs. This appeared in newborn lambs and because they were unable to stand and suckle, death resulted in a relatively short time. An analysis of the breeding data suggests that the characteristic is conditioned by a recessive gene but the indications are that modifying genes are involved as the symptoms exhibit a wide range of severity.

Open Faces and Heavy Fleeces

Many breeders have the opinion that open faces and heavy fleeces cannot be obtained in the same sheep. In the Lethbridge flock face cover has been scored on a numerical basis and these scores can be correlated to fleece weights. An analysis of the data showed that in this flock open faces were associated with heavier rather than lighter fleeces. This is interpreted to mean that as long as selection for open faces is accompanied by selection for heavy body weight, high density of wool, and long staple it is possible to obtain open faces and high fleece weights at the same time. It should not be construed to mean that heavier fleece weights automatically follow selection for open faces if no care is taken to select for heavy fleece weights as well.

Lambing Rates and Time of Lambing

The suggestion has been made that more twins are born early in the lambing season than late in the season. In order to check this the lambing records of the Lethbridge Station flock for the years 1935-39 were analysed. The summary of the analysis is shown in Table 27.

TABLE 27.—LAMBING RATES DURING VARIOUS PERIODS OF THE LAMBING SEASON FOR THE YEARS 1935-39

(On the basis of the number of ewes that lambed)

	Lambing Season		
	First ⅓	Second ⅓	Third ⅓
	lambs per ewe	lambs per ewe	lambs per ewe
Canadian Corriedales	1·51	1·47	1·40
Grade Rambouillets	1·60	1·53	1·39

These data indicate that there is a slight tendency for a greater number of twins to be born during the early part of the lambing season. The differences are relatively small and within individual years do not always apply. No definite reasons can be given for this situation.

Dairy Cattle Breeding

A herd of Holstein-Friesian cattle has been maintained at this Station for a number of years, the purpose being to build up a high-producing and high-testing herd of good type and conformation. As the dairy industry is of considerable importance in this locality, the Station herd has served a further purpose in supplying breeding stock to farmers. Since 1936, 64 males and 42 females have been sold for breeding purposes, mainly to farmers in the surrounding district.

Improved Production of Milk and Butterfat

Emphasis has been placed on increasing average production of milk and the percentage of butterfat in the milk. Considerable progress has been made in both factors. The average daily milk production was 32·4 pounds in 1937 and 40·9 pounds in 1946 or an increase of 8·5 pounds per day. At the same time the average butterfat content of milk increased from 3·32 to 3·71 per cent. This is a satisfactory improvement but the results are better still, if compared with 1931, when the average fat content of milk produced in the herd was only 2·88 per cent.

These changes are the result of careful selection of breeding males and females. Whole female families have been eliminated so that in 1946 only four female lines remained as compared with eleven in 1936. Individual selection within lines also took place.

The results show that record keeping and the use of records as a basis for selection can be effective in improving production of both milk and butterfat.

Sires Are Important

Careful selection of sires used in the herd has accompanied selection of females. A measure of a sire's breeding worth, as expressed by the performance of his progeny, is the sire index. The indexes for the four sires that have affected production in the herd since 1931 are presented in Table 28.

TABLE 28.—MILK AND BUTTERFAT INDEXES FOR FOUR HERD SIRES

Sire	No. of Dam-Daughter Pairs	Dams Average Corrected Milk Production	Dams Average Fat	Daughters Average Corrected Milk Production	Daughters Average Fat	Sire's Milk Index	Sire's Fat Index
		lb.	%	lb.	%	lb.	%
Mutual Pontiac Korndyke....	6	15,495	3·53	13,387	3·82	11,279	4·11
Hay's Calamity Rag Apple..	8	14,703	3·51	15,122	3·58	15,299	3·60
Hay's Mortgage Lifter.....	11	15,665	3·58	15,576	3·80	15,395	4·12
Colony Vrouka Sir Hengerveld 9th.....	10	14,773	3·73	15,104	3·76	16,000	3·76

The data in Table 28 show that each sire, at the time of his use in the herd, had a hereditary production potential above the herd average for either milk or fat or both and, therefore, an over-all increase in milk and fat production has taken place. Only when such a situation exists can improvement be obtained and this emphasizes the need for careful selection of all sires by any breeder who is seeking improvement of his herd.

Record of Performance

In recent years all cows freshening in the herd have been entered in R.O.P. In order to have a method for easy comparison of cows of different ages and lengths of lactation, an index, calculated by dividing actual production by required production, has been constructed.

For the 89 cows completing R.O.P. records during the last ten years the required production was 9,693 pounds of milk and 329 pounds of fat while the average actual production was 13,039 pounds of milk and 475 pounds of fat. The indexes of milk and fat production were 1·34 and 1·44 respectively, showing that the herd was well above the breed average.

Nutrition of Sheep

Rye Can Be Used For Fattening Lambs

Two lamb-feeding trials were conducted to test the value of rye as a grain for fattening lambs. Alfalfa hay was the roughage in each case and the grain used was barley in one group, one part barley and one part rye in a second group, and rye alone in a third group. The rye used was free from ergot which is important as ergot is poisonous. All other conditions were standardized for the three groups. The results showed that rye was satisfactory as a finishing grain. The gains made on rye alone or in combination with barley were equal to those made on barley. Feed consumption per pound of gain was the same in all groups.

No serious digestive troubles attributable to rye were encountered in either trial. The rye was not quite so palatable to the lambs as barley. There was no indication that rye had any adverse effect on the quality of the carcasses.

Rape-seed Meal For Lambs

Rape-seed meal is a high-protein feed recovered as a by-product from the production of rape-seed oil. It is a relatively new feed in Western Canada so it seemed desirable that information should be obtained regarding its value. Published reports from other sources indicated that this feed was relatively unpalatable but otherwise was quite suitable.

To provide further information an experiment was set up with newly-weaned ram lambs as experimental animals. The lambs were divided into two equal groups and placed on native pasture with ready access to water and to the shed where they were fed. Group 1 was fed rape-seed meal once daily to the full amount that they would consume. Group 2 was fed nutted linseed cake to the same amount.

The lambs on rape-seed meal at first would not eat this feed and it then was mixed with linseed until the lambs started to eat. They seemed to acquire a taste for the rape-seed meal and at the end of two weeks the linseed was removed from the mixture. At the conclusion of the trial they were eating ¼ pound per head daily of the rape-seed meal.

The lambs in Group 2, on linseed, took to this feed readily from the beginning of the trial.

The results obtained in this one preliminary experiment indicate that rape-seed meal can be used satisfactorily as a protein supplement for lambs. There was evidence of lack of palatability in the rape-seed meal though this was overcome by mixing the meal with a more palatable feed. No toxic effect of the rape-seed meal was noted during the course of the experiment.

Sun-Cured Pea-Vine Hay for Fattening Lambs

An experiment was conducted during the winter of 1945-46 to test the value of pea-vine hay, a new feed for this area. The grain ration for the various lots was the same and the roughage rations were alfalfa hay, pea-vine hay, and a mixture of alfalfa hay and pea-vine hay in equal proportions. The average daily gains for the three lots were 0·30, 0·30, and 0·25 pounds. The lots on alfalfa hay alone and pea-vine hay alone consumed practically the same amounts of roughage and grain per 100 pounds of gain, but the lot on mixed roughage consumed 100 pounds more hay and 100 pounds more grain per 100 pounds of gain than either of the other two lots. No reasons for this difference can be given and until additional results are obtained no definite conclusions can be drawn.

Vitamin A and Cobalt as Supplements

There is evidence to indicate that a deficiency of cobalt exists in certain areas of Alberta. Likewise, under certain conditions, vitamin A deficiencies may occur. To test the possible benefits of adding these ingredients to a ration for fattening lambs an experiment was undertaken. One group of lambs received neither supplement, one received vitamin A, and the third received cobalt sulphate.

The results obtained in the one experiment indicate that when legume hay, as fed in the experiment, was used no benefit was derived from adding either the cobalt or vitamin A to the ration. The same results might not occur under other conditions and in other areas.

DDT on Livestock Feeds

With the increased use of DDT in insect control and because of its known toxic effect to insects and to animals under certain conditions, it was deemed advisable to obtain further information regarding its possible toxic effect when present on feeds. The Entomological Division, Science Service, Lethbridge, sprayed some alfalfa plots with DDT for control of certain insects. This alfalfa was cut and made into hay which, on analysis, was found to contain 10 mg. DDT per kilogram of hay. This amount is slightly higher than the tentative safety standard of 7 mg. per kilogram.

The hay was used as the only feed for six shearling rams for a forty-day period (July 22 to August 30, 1946). During this period no undesirable effects, from the feeding of the hay, were noticed in the rams so it may be assumed that for the limited time that this feed was used the amount of DDT it contained was not detrimental to the sheep. Despite these results, care always should be taken in the use of any feed that may contain DDT.

Dairy Cattle Nutrition

Alfalfa Silage for Dairy Cows

Experiments were conducted with dairy cows to compare the feeding value of alfalfa silage and alfalfa hay in the ration of producing cows. The cows consumed the alfalfa silage readily but were unable to eat enough to provide them with as much dry matter as when they were consuming hay. This possibly was responsible for the results obtained.

The hay-fed groups gained more or lost less body weight than the silage-fed groups. The hay-fed groups produced more milk in each trial but this was offset to some extent by a higher fat content of the milk from the silage-fed groups. It is believed that the higher fat content was a result of lower milk yield and not a direct result of silage increasing fat percentage.

Without exception the decrease in milk yield was greater when the feed change from hay to silage was made than when the reverse change was made. In fact, in five out of eight changes from silage to hay, actual increases in production occurred, while a gradual decrease due to advance in the lactation period could be expected.

The best showing for silage was made in the second trial, when first-cutting hay and first-cutting silage were used. The poorest showing was made in the third trial when silage and hay from the second cutting of alfalfa were used.

On the basis of these results it may be concluded that alfalfa silage is not so satisfactory as good quality alfalfa hay when it constitutes the main part of the roughage ration. There were indications that better results might be obtained if alfalfa silage was used as a supplement to alfalfa hay rather than as the main source of roughage.

No difficulty was experienced in getting a good quality of silage when molasses was added at the rate of 30 pounds to each ton of green alfalfa placed in the silo. The costs of making the silage were relatively high because no special equipment for handling the heavy, green crop was available. Special equipment could overcome this difficulty to a large extent.

Nutrition of Beef Cattle

Pea-Vine Hay for Beef Cattle

An experiment with three lots of Hereford, range, yearling steers was conducted to test pea-vine hay for cattle. The roughages were alfalfa hay, alfalfa and pea-vine hay mixture, and pea-vine hay. The grain ration was the same for all groups. The average daily gains were 1·85, 1·79, and 1·89 pounds for the three roughages as listed above.

The feed consumption per hundred pounds of gain was practically the same for the alfalfa hay and the pea-vine hay groups but the group receiving the mixture required more hay and grain per hundred pounds of gain. These

results correspond with those obtained with lambs but no explanation can be offered why the mixed roughage did not give quite so good results as either roughage separately.

On the basis of this one experiment it may be said that alfalfa hay and pea-vine hay are of equivalent feeding value for fattening yearling steers. This was not unexpected in view of the close similarity in chemical composition of the two feeds.

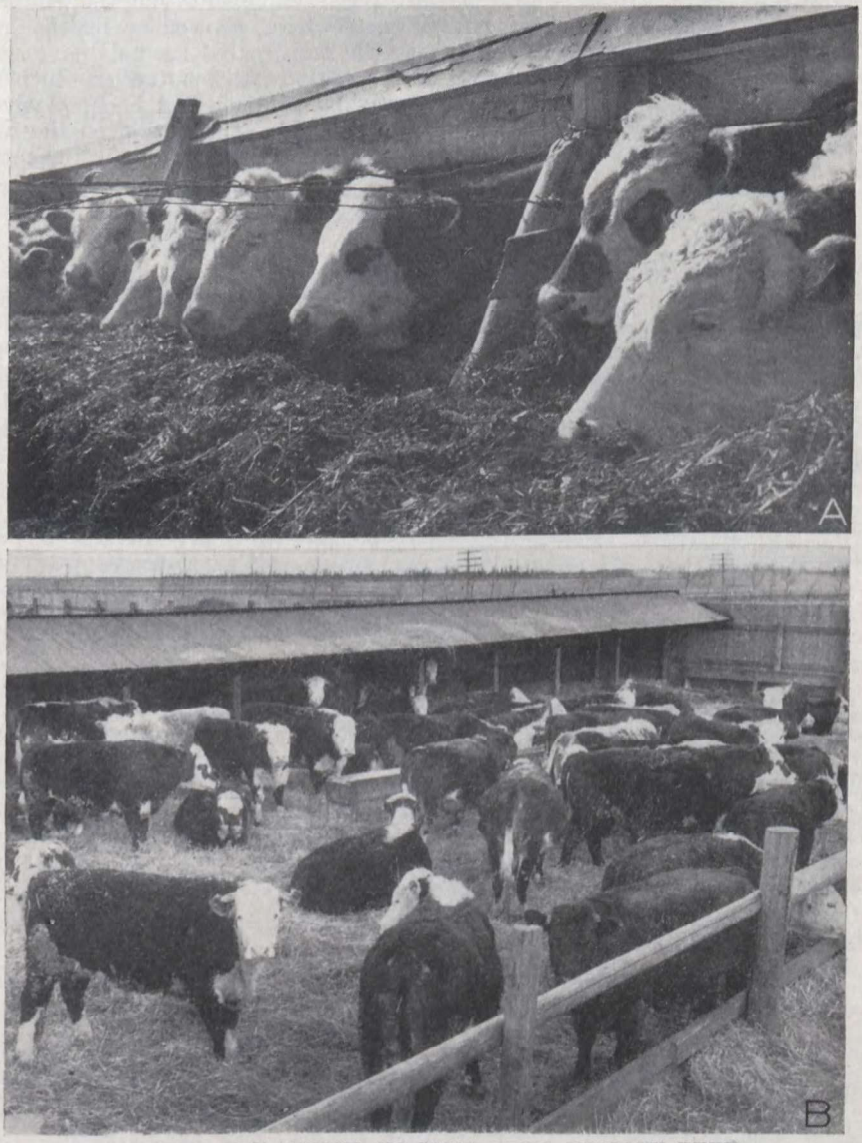


PLATE X—PUTTING THE FINISH ON SOME HIGH QUALITY BEEF.

A. Steers feeding on pea-vine silage, a by-product of one of the main canning crops grown under irrigation in southern Alberta. Sugar beet pulp also is used extensively for feeding in this area.

B. View of a well arranged feedlot with ample bedding and adequate protection against prevailing winds and periods of stormy weather.

Vitamin A Supplement for Feeder Steers

While definite evidence is not available that vitamin A deficiency occurs in range cattle the conditions under which they exist during drought years suggest the possibility that the vitamin A supply may be lowered to a point where it might affect normal development and reproduction. To test the influence of a vitamin A supplement on the feedlot performance of yearling steers from ranges of southeastern Alberta an experiment was conducted during the winter of 1945-46. The results, in terms of gain in the feed lot, showed no benefit from the supplement but other conditions among the non-treated animals gave some indication of a vitamin A deficiency. As the grass conditions under which the steers had been maintained during the preceding summer had been relatively favourable, further tests will be conducted to provide information on the need for vitamin A in drought years when little green growth is available to the cattle.

Production and Management of Sheep

The Economics of Raising Twin Lambs

A statement often made by range sheep producers is that it is not worth their while to raise twin lambs because twins do not grow as big as singles. In view of the fact that a rancher's income is determined to a large extent by the number of pounds of lambs available for sale in the fall the practice of not raising twins possibly should be re-examined. In order to obtain some data applicable to this problem an analysis was made of the weaning weight data from the Lethbridge Station flock. A summary of the basic data is provided in Table 29.

TABLE 29.—AVERAGE WEANING WEIGHTS OF TWIN AND SINGLE LAMBS 1940-42

—	Singles	Twins Raised Single	Twins Raised as Twins	Difference Between Twin Classes
	lb.	lb.	lb.	lb.
Males	72·5	72·2	63·6	8·6
Females	74·4	72·7	66·1	6·6
Wethers	73·5	73·2	66·9	6·3

These data substantiate the contention that lambs raised as twins are lighter at weaning time than lambs raised as singles. The data also show only a minor weaning weight difference between lambs born single and lambs born as twins and raised single, despite the average lower birth weight of twins.

However, the above analysis tells only part of the story and the remainder is brought out in Table 30.

TABLE 30.—AVERAGE PRODUCTION OF POUNDS OF LAMB PER EWE 1940-42

—	Ewes That Raised Singles	Ewes That Raised Singles From Twins	Ewes That Raised a Set of Twins	Difference in Favour of Set of Twins
	lb.	lb.	lb.	lb.
Males	72·5	72·2	127·2	55·0
Females	74·4	72·7	132·2	59·5
Wethers	73·5	73·2	133·8	60·6

These data throw a different light on the subject. It is evident that ewes that raised twins produced substantially more pounds of lamb during a season than ewes that raised singles, despite the individually lower weights of the twins. This would indicate that killing a twin lamb may not be good economic procedure.

It is admitted that some poor specimens develop when many twins are kept but it would appear to be desirable to keep all normal twins on ewes that are in good condition and give evidence of having a good supply of milk.

Spraying Sheep for Ked Control

Dipping sheep has been the common means of controlling sheep keds for many years. It is a laborious process and is relatively hard on the sheep. Consequently, steps were taken to develop an easier method that would be both economical and practical. It was thought that the numerous power sprayers that were being used for warble fly control in cattle could be used for applying dip mixtures to sheep.

Accordingly, an experiment was undertaken in 1945 and continued in 1946 to study the spraying of sheep for ked control. In addition to studying the effectiveness of application by spraying a test also was made of different standard sprays as well as the new insecticide, DDT. In 1945 lambs were used as experimental animals and in 1946 yearling ewes were employed.

The results of the experiment showed that spraying with a power sprayer was simple, effective, and easier on both the sheep and men involved than the old practice of dipping. The amount of material required was about the same for each method.

All standard commercial dips can be applied with the sprayer and if the materials are effective as dips they also will be effective if applied with a sprayer. DDT gave excellent control of sheep keds.

Production and Management of Dairy Cattle

Cost of Maintaining the Dairy Herd Sire

The herd sire is an important individual in any dairy herd and as a result he should have adequate care and feeding. Expensive feeds are not necessary but a reasonable quantity of good quality meal and roughage is required. Housing accommodation does not have to be elaborate but it should be sturdy and contain ample room for exercising. The average yearly costs of maintaining a herd sire over a period of four years at the Station are presented in Table 31.

TABLE 31.—FEED CONSUMPTION AND FEED COSTS FOR A HERD SIRE FOR THE YEARS 1937-40

—	Meal	Hay	Silage	Cost
	lb.	lb.	lb.	$
1937	4,176	9,149	.....	116 04
1938	3,356	8,228	.....	78 60
1939	3,263	8,150	.....	65 23
1940	2,580	6,017	4,345	52 55
Total	13,375	31,544	4,345	312 42
Average	3,344	7,886	1,086	78 10

The average cost for the four-year period is not extreme although with increased prices during and following the war the yearly feed cost would be considerably higher than that shown.

Periodic Cost of Rearing Dairy Females

Replacement of cows in the dairy herd is of greatest importance. Females must be raised and developed in such a manner that the cost of raising and developing them is less than the cost of purchasing equally desirable heifers of milking age. As with the herd sire, elaborate housing facilities and expensive rations are not necessary but a sufficient quantity of meal and roughage of satisfactory quality should be provided.

Records on thirty-six heifer calves raised to six months of age showed that 468 pounds of whole milk, 1,799 pounds of skim-milk, 343 pounds of grain, and 415 pounds of hay were required per calf with the system of feeding used. This system of feeding produced well developed calves capable of continued satisfactory growth.

During the period from six to twelve months of age, the average consumption was 1,211 pounds of skim-milk, 445 pounds of grain, 750 pounds of hay, and 100 days on pasture.

Feed Costs of Milk Production

Feed cost of milk production is the factor which determines whether an individual animal is returning a profit or a loss to the owner. As such, feed cost is deserving of very serious consideration in a dairy herd.

Feed costs for ten years, 1937 to 1946 inclusive, are presented in Table 32.

TABLE 32.—SUMMARY OF AVERAGE PRODUCTION, QUANTITIES OF FEED, AND COST OF FEED FOR PRODUCING MILK AND BUTTERFAT

Year	Average Production		Feed Cost, Dollars		Feed Consumed per 100 lb. Milk			
	Milk	Fat	per 100 lb. Milk	per 1 lb. Fat	Meal	Ensilage	Hay	Pasture
	lb.	lb.			lb.	lb.	lb.	days
1937	11,491	381	0·61	0·18	18·0	4·0	58·4	1·32
1938	12,794	447	0·71	0·21	23·1	.....	62·3	1·13
1939	12,913	456	0·52	0·15	19·8	9·3	57·6	1·31
1940	13,215	469	0·48	0·13	19·8	51·3	40·7	1·10
1941	12,529	440	0·53	0·15	26·5	53·7	38·4	1·04
1942	14,840	528	0·58	0·16	33·6	35·6	39·8	1·00
1943	12,512	463	0·73	0·20	36·7	40·1	59·5	1·05
1944	14,134	505	0·67	0·19	25·2	2·3	41·9	1·30
1945	13,590	500	0·70	0·19	19·9	.....	53·9	1·06
1946	13,690	508	0·78	0·21	18·5	.....	68·4	1·06

It is evident from these data that, provided the nutrient requirements of the cows are satisfied, managerial practices can go a long way in reducing the feed costs of milk and fat production. This is particularly evident in the use of pasture where the longer the pasture season the lower was the cost of feed per hundred pounds of milk or per pound of fat.

A similar situation arises between two cows in the same herd. The feed cost per 100 pounds of milk may be as much as 30 cents lower for a high producing cow than for a low producing cow.

A general increase in cost of production has occurred in recent years. This has been caused by rising feed prices during the later war years and those following the cessation of hostilities.

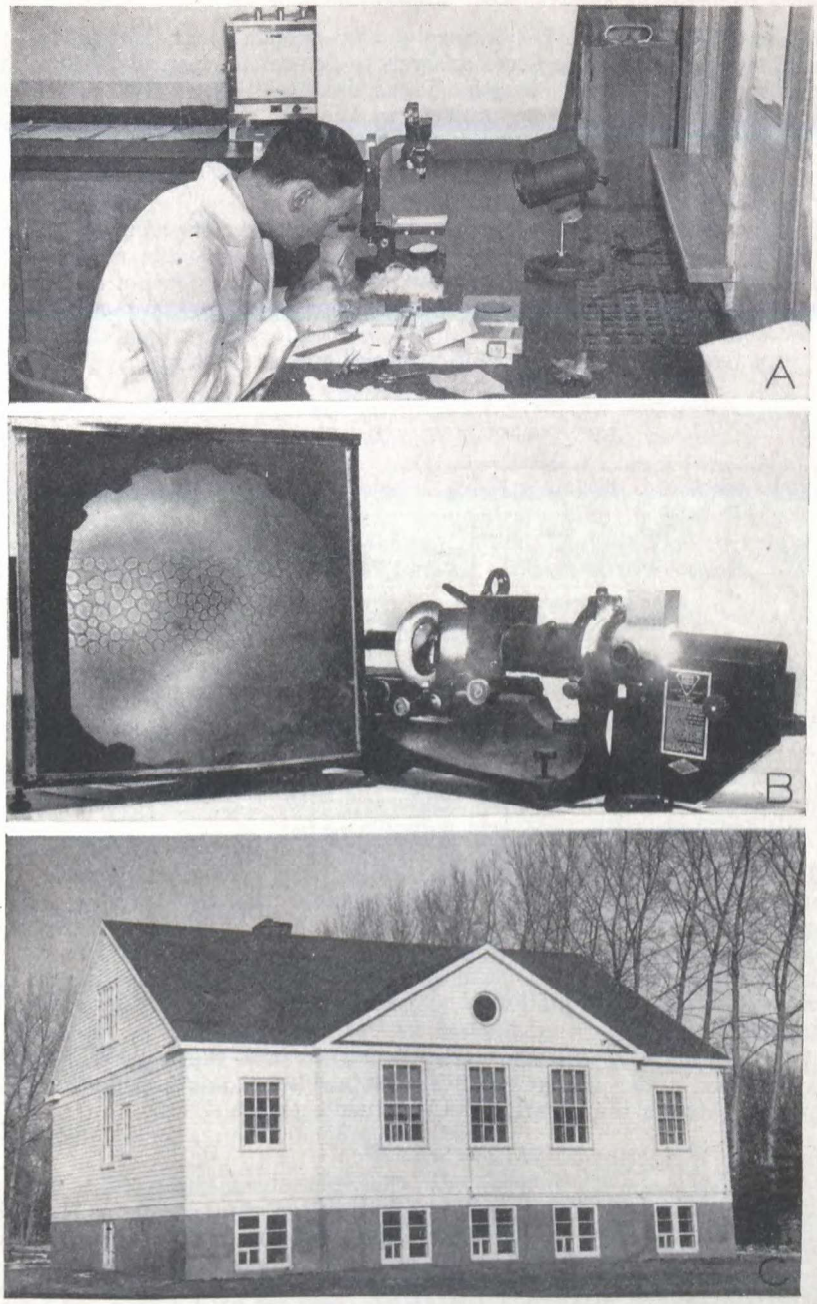


PLATE XI—WOOL LABORATORY, EXPERIMENTAL STATION, LETHBRIDGE.

A. Preparing slides of cross-sections of wool fibres for diameter measurements.
B. Enlarged cross-sections of wool fibres.
C. Wool laboratory building at the Lethbridge Station where fleece analysis studies are centred.

Wool

A new Wool Research Laboratory started operations at the Station in 1946. Its primary function will be fleece analysis to determine clean yield, fibre fineness and uniformity, and staple length. These data will be utilized in selection of sheep in the various breeding projects in Western Canada. Previous to 1946 these analyses were carried out by the National Research Council in Ottawa.

Grease Fleece Weights

The primary data in any fleece weight analysis are the weights of fleeces as they are removed from the sheep. These weights include the actual weight of wool, natural oils or grease, suint or sweat products, and foreign matter such as soil and vegetable matter. In order to provide a picture of annual fluctuations that occur and also to show breed differences under similar conditions, data for ewe fleeces from the Lethbridge Station flock have been summarized in Table 32*a*.

TABLE 32A.—AVERAGE WEIGHTS (IN POUNDS) OF FLEECES FROM EWES IN THE LETHBRIDGE STATION FLOCK 1940-46

—	Mature Ewes				Shearling Ewes			
	N.Z. Corriedale	Can. Corriedale	Ramb.	Cross-breds	N.Z. Corriedale	Can. Corriedale	Ramb.	Cross-breds
	Average Weight	Average Weight	Average Weight	Average Weight	Average Weight	Average Weight	Average Weight	Average Weight
1940	11·6	11·1	11·7	11·8	7·8	8·2	7·4	8·1
1941	11·0	10·7	11·7	10·9	8·5	8·1	8·0	7·8
1942	11·8	11·1	13·0	12·2	10·1	8·6	9·4	9·0
1943	9·8	9·2	9·8	9·5	9·0	8·1	8·6	8·2
1944	9·8	9·7	11·9	10·1	8·6	6·5	8·0	7·4
1945	11·3	10·8	12·6	11·2	11·8	9·4	10·2	9·2
1946	11·5	11·0	12·8	11·2	9·1	7·8	8·7	9·3
7-Year Average	11·0	10·5	12·0	10·9	9·2	8·1	8·7	8·6

It will be noted that within breeds there have been relatively wide, annual fluctuations in average weights. These annual changes may be caused by changes in actual amount of clean wool produced because of nutritional factors; changes in the relative proportion of grease and suint contained in the fleeces because of climatic conditions; and changes in the proportion of foreign matter, especially soil matter. Usually it is a combination of these various factors that is involved.

The data in Table 32*a* also show breed differences that exist when the sheep are maintained under similar conditions. Likewise, the differences that occur in production between the shearling and mature ages are shown.

Clean Fleece Weight and Yield of Clean Wool

By scouring samples of wool from fleeces the percentage clean wool in the fleeces can be determined and the amount of clean wool can be calculated from the grease-wool weights. The data obtained have shown marked annual fluctuations in the per cent yield, indicating that differences in grease, suint, and foreign matter occur. Climatic conditions largely are responsible for these variations and the data emphasize the need for wool being sold on the basis of its clean wool yield rather than simply on a basis of weight of greasy wool. For example, in 1943 the Rambouillet shearling ewe fleeces had an average yield of 57·9 per cent clean wool, whereas, in 1946 the yield was only 45·3 per cent.

Fibre Thickness

Fibre thickness is a measure of the quality of wool and the determination of average fibre thickness in fleeces is quite important. Commercially this determination is made by graders, by visual observation, but the accuracy of such observations is subject to considerable variation. Actual measurement of fibres from the fleeces is more precise and provides reliable data on which to base selection of breeding stock.

Fibre thickness does not fluctuate from year to year to nearly the same extent as fleece weights, though some changes occur. These changes in fleeces from individual sheep are caused mainly by variations in the level of nutrition or by sickness. Hereditary differences between breeds and between individuals within breeds exist but these differences do not change noticeably from year to year.

POULTRY HUSBANDRY

The Barred Plymouth Rock flock at the Station was established in 1914 and until 1935 was maintained on the basis of introducing outside stock at intervals. In 1935 the flock was closed to further outside blood and has been maintained as a closed unit since that time. From 1936 to 1942 there was no directed inbreeding but since 1942 definite inbred lines have been established. Selection, based on individual characteristics and progeny records, has been continued.

Breeding

Egg Size can be Increased

In years gone by the eggs produced by birds of the Barred Plymouth Rock breed have on the average been below the desired standard. The same was true in the Station flock as indicated by the fact that in 1935-36 the average egg size was 22·4 ounces per dozen. Through careful selection of the breeding stock this had been raised to 26·3 ounces per dozen in 1945-46. In fact, progress had been so good that many pullets were laying eggs that were too large and some selection toward smaller eggs may have to be practised.

Egg Production Maintained

No special effort has been made in recent years to select for increased production though birds of low production have not been used as breeders. It has been shown that under this procedure egg production can be maintained at the relatively high level of 200 eggs for all normal pullets in their first year of production. This production has been maintained despite increase in egg size, so the total weight of eggs produced has been increased.

Fertility, Hatchability, and Livability of Chicks

The three factors, fertility, hatchability, and livability of chicks, are highly important in the production of replacement stock in poultry flocks. In the Lethbridge flock the average fertility was increased from 77·6 per cent in 1937 to 92·6 per cent in 1946. Hatchability of fertile eggs increased from 61·9 per cent to 73·9 per cent in the same period and hatchability of all eggs set increased from 48·7 per cent to 67·5 per cent. No change took place in livability of chicks to three weeks of age but it was at the relatively high figure of 97·1 per cent.

Unfortunately a specific answer is not available regarding what factors are responsible for this improvement as changes in nutrition, incubator management, and breeding all have occurred and all have contributed.

Hereditary Abnormalities

Split Wings.—In all breeds of poultry there are undesirable characteristics present. Some of these are classed as disqualifications and cause loss through culling in the breeding flock. One such characteristic, found in the Station flock, is "split wing", which is a malformation of the wing caused by incomplete development of the axial feather. Culling of birds showing this characteristic should have kept the incidence of this characteristic at a low level but in 1937 the number of affected birds started to increase. This is shown by the data in Table 32*b*.

TABLE 32B.—THE INCIDENCE OF WEAK AND SPLIT-WING BIRDS IN THE LETHBRIDGE STATION FLOCK

Year	Chicks from Brooders	Number Culled for Wing Defects	Per cent Culled
1934	1,209	29	2·4
1935	1,583	19	1·2
1936	1,586	40	2·5*
1937	1,978	75	3·8
1938	1,929	117	6·1
1939	1,898	361	19·0
1940	1,323	172	13·0
1941	1,554	165	10·6
1942	1,357	172	12·7
1943	1,749	253	14·4
1944	1,194	344	28·8
1945	1,243	210	16·9
1946	1,615	239	14·8

*All the 1936 birds were removed in the early summer of 1937 so this figure may be slightly low.

The high point was reached in 1944 when 28·8 per cent of the birds were culled because of poor wings. This was a serious loss and occurred despite removal of all affected birds from the breeding flock for several years.

No information was available on the inheritance of this characteristic so a breeding project was instituted to provide data to guide a more effective program for the elimination of the defect, not only for the Station flock but for poultry breeders in general. This involved attempts to establish a flock free from the defect and a flock pure for the defect. By selection and inbreeding, this latter flock has been developed but a flock free from the defect still is being sought. This indicates that the defect has a hereditary basis but suggests some complexity in the mode of inheritance or a high frequency of the gene responsible for the defect.

At the present time the only recommendation that can be made is that no birds showing the defect, in even a mild form, should be used for breeding purposes.

Crazy Chicks.—For some years isolated cases of an abnormality of the nervous system of newly hatched chicks have been observed in the Station flock. Reports have been received of similar chicks occurring in commercial hatcheries. The abnormality apparently affects the nervous system with the main symptoms being a retracted head (which causes the birds to be unbalanced and unable to stand), almost constant leg movement when the bird is prone on its side, and a distinctive chirp. In all other respects the birds appear to be normal. They are fully developed and feathered at hatching time and appear to be as strong physically as normal chicks. Because of their inability to stand and eat their life span is very limited.

In 1945 the number of abnormal chicks in the Station flock showed a noticeable increase and again in 1946 the increase continued so that 3·9 per cent of all chicks hatched showed the abnormality. The incidence varied from 0 in some sire progeny groups to 18·2 per cent in the worst affected group.

In co-operation with the Poultry Division, Central Experimental Farm, Ottawa, preliminary tests were made to study the possible nutritional deficiencies but only a very limited amount of work could be done with the material that was available. The results were far from conclusive but at the present stage of knowledge there is a logical basis for questioning the nutritional deficiency theory.

A preliminary study, to determine if genetic factors were at work, was made on the basis of pedigree analysis. While the results are not conclusive the evidence at present favours the theory that there is a genetic base for the abnormality. No evidence can be adduced to indicate the mode of inheritance but apparently it is somewhat complex.

Management

Normal Mortality in Young Stock

Death losses eat up profits so that reducing mortality is of primary importance. Healthy, vigorous birds plus good management can keep losses at a minimum but cannot eliminate them entirely. During the past ten years the average mortality from hatching to laying house has been about eleven per cent. During the first three weeks in battery brooders the losses were 1·7 per cent, in the longer period in the brooder houses the loss was 5·1 per cent, and in the final period on range 4·3 per cent for pullets and 7·5 per cent for cockerels. These losses include accidental deaths and deaths caused by stray dogs and other predators. No disease epidemics have been encountered so these data indicate what may be expected under good conditions of management.

Capons Require a Premium Market

In the 1936 report reference was made to experiments on the production and marketing of capons. This work was continued until 1938. In summarizing the results it can be said that no practical difficulties were encountered in capon production. Death losses due to the operation were small and other death losses were reasonable. The birds grew well and developed into acceptable market birds but the cost of producing them was too high in relation to market price. The conclusion was reached that for capon production to be a profitable venture a special market with a premium price would have to be developed. Such a market did not exist in the area served by this Station.

Effect of Artificial Lights on Fertility and Hatchability

An experiment was conducted in 1937 and 1938 to determine the effect of artificial lights on fertility and hatchability but unfortunately this work had to be discontinued before it was completed. Several different light treatments were used but as the data were limited it was not possible to determine definitely the effectiveness of the various treatments. However, by grouping all the light treatments and comparing them with the no-light treatment the results obtained indicate that exposing the breeding birds to artificial lights during the breeding season increased the proportion of fertile eggs produced. Likewise, an improvement in hatchability of fertile eggs was obtained from the light treatment.

DISTRICT EXPERIMENT SUBSTATIONS

District Experiment Substations are privately owned farms where problems are studied in their local environment. These investigations constitute an important extension of the comprehensive work conducted on the Experimental Farms and Stations. In Alberta at present, 27 Illustration Stations and District Experi-

ment Substations serve the outlying areas surrounding the Dominion Experimental Stations at Lethbridge, Lacombe, and, further north, at Beaverlodge in the Peace River District. The work conducted on the Illustration Stations and Substations has been continually broadened in scope and has progressed from the original purpose of disseminating experimental results by field and cultural demonstration to the establishment of various fact-finding experiments.

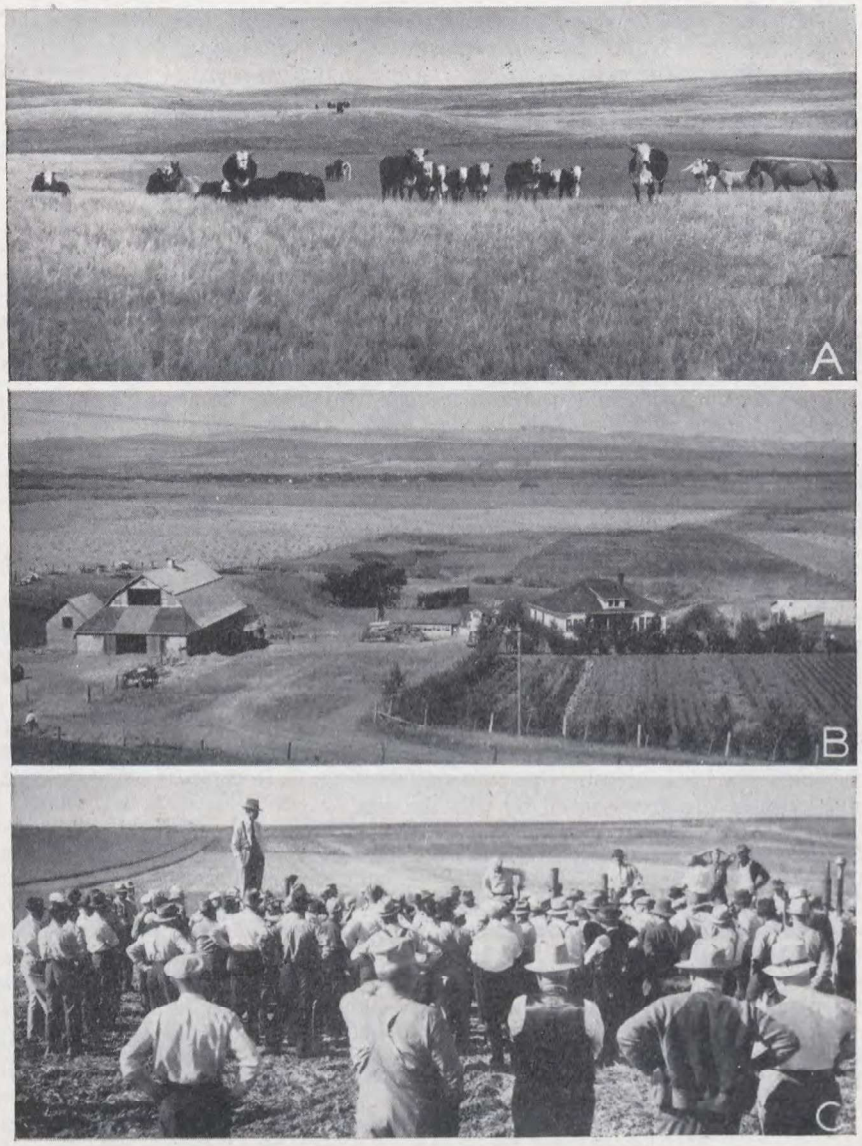


PLATE XII—DISTRICT EXPERIMENT SUBSTATIONS

Ten of these fact-finding stations are operated from Lethbridge.

A. Hereford cattle on range land at the Acadia Valley station where livestock is an important source of income.

B. The farmstead at the Pincher Creek station where mixed farming is followed.

C. A field day at the Nobleford station which is located in a wheat growing area.

The production of suitable varieties of cereals and forage crops is promoted on the Illustration Stations and Substations in order that these farms may serve as sources of pure seed for farmers in surrounding districts. Strip farming, soil erosion control, and the introduction of improved cultural practices are important phases of the work on Station farms in Alberta.

Livestock policies, which are designed to promote the development of improved herds of cattle and swine as well as flocks of sheep and poultry from which neighbouring farmers may procure breeding stock, are an integral part of substation activities.

Farm management studies as well as farm beautification are other projects designed to acquire information on the most economical methods of production and to promote those features which contribute to financial effectiveness and also those which enhance the comfort and attractiveness of farm living.

There are ten District Experiment Substations and two special-project stations in the territory supervised from the Lethbridge Experimental Station. They are located in the southern part of the province south of the Goose Lake line of the C.N.R. running through Hanna, Drumheller, and Calgary. The great variety of soils and climate peculiar to the individual substations permits investigation of agricultural practices under a wide range of conditions. Detailed soil surveys made on each substation show that all major soil textures from fine sandy loam at Claresholm to clay at Acadia Valley and Drumheller are represented. Precipitation increases from east to west. At Bindloss near the Saskatchewan boundary the average annual precipitation is about ten inches, while at Pincher Creek in the Rocky Mountain foothills it is about twenty inches. A summary of precipitation records collected through varying periods of years, showing the differences between different districts in amount and distribution throughout the crop season, is presented in Table 33. Some of the more important fields of work being given attention in southern Alberta are the control of wind and water erosion, cereal variety testing, the use of fertilizers, crop rotations and soil management, and the control of weeds and insect pests.

Throughout this report where reference is made to certain districts it relates to the work being developed in co-operation with the farmers listed in Table 34 as operators of District Experiment Substations.

An account of investigations being conducted at Dalroy and Taber will be found in the Weed Control and Horticulture sections respectively of the main Experimental Station report.

TABLE 33.—AVERAGE PRECIPITATION ON SOUTHERN ALBERTA SUBSTATIONS

To December 31, 1946

Substation	Years	Fall	Winter	Summer				Crop Year	Calendar Year
		Aug. 1-Oct. 31	Nov. 1-Mar. 31	April	May	June	July	Aug. 1-July 31	
		ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Brown Soil Zone—									
Acadia Valley	7	3·02	2·13	0·60	0·96	2·33	1·09	10·13	11·00
Bindloss	22	2·67	1·75	0·70	1·31	2·16	1·33	9·92	10·05
Foremost	17	3·20	3·21	1·04	1·49	2·67	1·25	12·86	13·86
Lomond	11	2·48	1·84	0·63	1·79	2·19	1·57	10·50	10·83
Whitla	23	3·02	3·25	0·99	1·74	2·21	1·33	12·54	12·92
Dark-Brown Soil Zone—									
Claresholm	9	4·39	3·75	0·94	2·43	2·89	1·68	16·08	16·22
Craigmyle	7	3·39	2·50	0·76	1·21	3·24	2·53	13·63	14·89
Drumheller	9	4·21	3·25	1·05	1·46	3·50	2·10	15·57	15·55
Nobleford	14	3·17	2·86	0·81	1·79	2·54	1·40	12·57	12·81
Shallow-Black Soil Zone—									
Pincher Creek	25	5·47	5·37	1·55	2·30	3·87	1·55	20·11	20·48

TABLE 34.—LOCATION OF DISTRICT EXPERIMENT SUBSTATIONS AND SPECIAL-PROJECT STATIONS IN SOUTHERN ALBERTA

Location	Operator
Brown Soil Zone—	
Acadia Valley	W. A. Heiden
Bindloss	J. Barnes
Foremost	C. G. Wolfe
Lomond	E. M. Benson
Whitla	W. N. Babe
Dark-Brown Soil Zone—	
Claresholm	D. L. Reynolds
Craigmyle	J. L. Branum
Drumheller	Andrew Brothers
Nobleford	Chris. T. Withage
Shallow-Black Soil Zone—	
Pincher Creek	E. P. Cyr
PROJECT STATIONS	
Dalroy	
Taber	

CROPPING SYSTEMS FOR PRAIRIE FARMS

Fallow-Wheat

The fallow-wheat rotation is used almost exclusively on all substations except Pincher Creek. Moisture is the limiting factor on substations on the open prairies and on these the reserve moisture in stubble usually is not great. Hence the reason for the tendency to grow wheat on fallow only. Most of the substations are situated in the recognized high quality wheat producing area. Frost is not a hazard except occasionally at Drumheller and Craigmyle.

The long-time average yields of wheat on fallow are presented in Table 35.

TABLE 35.—AVERAGE YIELDS PER ACRE OF WHEAT AFTER FALLOW

Substation	Years	Yield
		bus.
Acadia Valley	8	22·8
Bindloss	22	14·2
Foremost	10	12·9
Lomond	12	13·5
Whitla	22	12·6
Claresholm	10	21·2
Craigmyle	8	21·1
Drumheller	10	18·3
Nobleford	8	28·8

Fallow-Wheat-Wheat

The production of wheat on stubble is not a general practice in southern Alberta as reserve moisture in stubble at seeding time usually is not great. Insect pests, particularly wheat stem sawfly, pale western cutworm, and grasshoppers are destructive to stubbled-in crops.

Yields have been recorded during the past nine years and are presented in Table 36.

TABLE 36.—AVERAGE YIELDS PER ACRE OF WHEAT ON FALLOW AND STUBBLE 1938–1946

Substation	On Fallow	On Stubble
	bus.	bus.
Acadia Valley	21·6	13·0
Bindloss	16·1	7·1
Foremost	12·5	7·6
Lomond	15·4	6·4
Whitla	8·9	4·8
Claresholm	23·6	16·5
Craigmyle	21·3	13·2
Nobleford	29·8	16·4
Pincher Creek	33·9	23·3

The data presented in Table 36 indicate that low average yields can be expected in the low rainfall areas if wheat is seeded on stubble every year. However, even in these areas good yields occasionally are obtained as in 1942 when the yields at Bindloss, Foremost, Lomond, and Whitla were respectively 18·0, 16·0, 19·0, and 17·5 bushels per acre. The risk of crop failure in the drier areas is decidedly lessened if there is an adequate reserve of subsoil moisture at seeding time.

Satisfactory average yields of wheat on stubble can be expected in the areas of higher rainfall represented by Claresholm, Nobleford, and Pincher Creek. Seeding stubble is practised to a certain extent in these districts. When seeding stubble is contemplated, factors to be considered include reserve soil moisture, insect pests, and weeds. Seeding stubble reduces the percentage of land in fallow, and since most soil drifting occurs on fallow, the seeding of stubble when conditions are favourable is worthy of consideration.

Fallow-Flax-Wheat

This rotation has been carried on at Nobleford since 1940 for wheat stem sawfly control. Since flax is immune to sawfly attack, two years are available for eliminating sawflies. For sawfly control this rotation has been entirely satisfactory and yields obtained indicate that returns are reasonably good.

The yields that have been obtained in the past seven years with this rotation are shown in Table 37.

TABLE 37.—YIELDS PER ACRE FROM A FALLOW-FLAX-WHEAT ROTATION AT NOBLEFORD

Year	Flax on Fallow	Wheat on Flax Stubble
	bus.	bus.
1940	20·5	30·0
1941	8·0	7·5
1942	25·0	39·0
1943	11·3	4·0
1944	3·6	1·2
1945	10·0	13·7
1946	10·7	17·4
Average	12·7	16·1

There are certain disadvantages in this rotation. Flax leaves a very light stubble, and, as will be noticed, light crops of wheat were harvested in three years out of seven. In these three years light stubbles were available for the fallow year and consequently it was not possible to prepare an adequate trash cover to prevent soil drifting. There is more risk in producing flax than wheat, and weeds and grasshoppers frequently are a problem.

Chemical Fertilizers for Wheat

Chemical fertilizer tests were conducted from 1937 to 1942 and again in 1947. A comparison of various phosphate fertilizers was made in rod-row plots with the following rates of application: 15 and 25 pounds ammonium phosphate 11-48; 15, 25 and 38 pounds ammonium superphosphate 2-19; and 20 pounds triple superphosphate 0-43-0 per acre. In addition, on each station a 13- to 20-acre field was fertilized at 20 pounds per acre with ammonium phosphate 11-48 and the yield compared with that of an adjoining field where no fertilizer was applied.

In these tests increases from fertilizers were obtained on the heavy soils at Drumheller, Pincher Creek, and Acadia Valley. In small plot tests the average increases were respectively 2·4, 4·8, and 3·0 bushels per acre. On a field scale the average increases at Pincher Creek and Acadia Valley were respectively 2·7 and 1·2 bushels per acre. At all other substations no significant increases were obtained.

Crested Wheat Grass for Restoring Soil Fibre

An acreage of crested wheat grass was seeded on all substations and has been broken up during recent years. Sufficient time has not elapsed to determine the value of the practice. However, the following observations are presented on results to date. Crested wheat grass will restore fibre to the soil and the rate of restoration depends on the kind of growing seasons rather than on the number of years it is left down. Yields of grain are likely to be depressed following breaking. The immediate value of this practice would seem to be greatest on lands devoid of fibre in those dry, low-producing areas where land is plentiful and cheap and where livestock is maintained.

Control of Weeds by Cultural Methods

On the open plains the control of weeds is of importance chiefly as a moisture conservation practice. Reserve moisture is stored during the fallow year and for maximum conservation, moisture-consuming weed growth must be kept at a minimum.

Russian thistle is the most prevalent weed and is present every year. Tumbling mustard and stinkweed also are present but not so extensively as Russian thistle.

Early Spring Cultivation.—For a number of years the value of an early spring cultivation was tested. A strip was shallow cultivated as soon as possible in the spring, and cultivated again and seeded 7 to 10 days later. This strip was compared with one that did not receive an early cultivation. Results indicate that there is not much advantage from the early cultivation provided a good job of weed killing is done immediately before seeding or in conjunction with the seeding operation. In the majority of cases there was no difference in the weed infestation or yield. However, in no case were weeds more prevalent or the yield lighter on the strip that received the early cultivation.

Blading After Harvest.—The value of blade cultivating stubble immediately after combining has been tested in recent years. Such an operation has resulted in fewer weeds the following year. This operation is particularly valuable if stubble land is likely to be seeded.

Stinkweed Control.—The control of stinkweed at Pincher Creek and Drumheller has been effected by a thorough, shallow cultivation immediately before seeding. It has been practically impossible to eradicate stinkweed by cultural methods alone but the practice followed makes competition as favourable as possible for the grain crop.

Wild Oats Control.—Wild oats are easily controlled on the drier substations by fallowing, but this weed presents a real problem at Pincher Creek and Drumheller. Several ideas have been tested but certainly no easy method of control is indicated. The basis of control has been to grow wild oats out of the soil and prevent further infestation. Fairly good success has been obtained by killing two or three stands of wild oats and seeding Olli barley about the end of May. When the barley has sprouted the field has been rod weeded to kill another crop of wild oats. It will be seen that the success of this practice depends largely on weather conditions.

Cultural Treatments for Summerfallow

Methods of summerfallowing used on southern Alberta substations are designed to conserve moisture and prevent soil drifting. This necessitates procedures that prevent moisture-consuming weed growth and which leave the land protected by a good trash cover. It is not possible to give definite procedures because the quality of work done by various cultural implements is influenced by many factors, including soil texture, soil moisture conditions, and the amount of stubble. Implements used on all substations include the blade cultivator, one-way disk, duck-foot cultivator, and rod weeder.

The blade cultivator is used extensively because it leaves practically all the trash on the surface. It does its best work under fairly dry conditions and when operated at high speeds.

The one-way disk does excellent work in heavy stubble. However, if used for more than two strokes or at speeds above three and one-half miles per hour, too much trash is buried. The one-way disk kills weeds more effectively than the blade cultivator.

The duck-foot cultivator has not been used extensively in recent years but when carefully operated at not over three and one-half miles per hour it leaves most of the trash on the surface. One of its main objections is its tendency to plug in heavy stubble.

The rod weeder does good work when soil conditions are suitable and where there is not too much trash to cause plugging. Rod weeders, usually, are 20 feet wide as compared with 8 to 12 feet for other cultural implements, and are easily pulled by a light tractor.

The first operation in starting a fallow is very important since this stroke can be the deciding factor in establishing an adequate trash cover. Operators have used the blade cultivator for the first stroke and then followed a little deeper with the one-way disk for the second stroke. Reversing the order of these two implements has also been satisfactory. Subsequent strokes have been made with the rod weeder, duck-foot cultivator, or blade cultivator, whichever proved suitable for the prevailing soil conditions.

Emergency conditions may arise where there is not sufficient trash to provide adequate protection. A lumpy surface created by late fall ploughing has proved effective in preventing drifting on medium textured soils, but lister furrows four feet apart have been more effective than ploughing on sandy and clay soils.

Erosion Control

Strip Farming

Strip farming, with careful handling of the fallow strips, has proved effective in controlling soil drifting on all substations since their establishment in 1935. Strips vary in width from 10 to 20 rods depending on soil type and the velocity of winds usually experienced. Strips 10 to 13½ rods wide have been established on sandy soils and heavy clay soils, while on medium textured soils, strips 16 and

20 rods wide have been used. The direction of the strips is north and south on most substations but in a few cases east and west strips have been used.

Table 38 shows the soil mixture, width of strips, direction of strips, and prevailing wind on southern Alberta substations.

TABLE 38.—STRIP FARMING PRACTICES ON SOUTHERN ALBERTA SUBSTATIONS

Substation	Soil Texture	Width of Strips	Direction of Strips	Prevailing Wind
Acadia Valley	Clay	10, 13½	N and S	NW, SW
Bindloss	Silt loam	16	N and S	NW, SW
Foremost	Silt loam	20	N and S	NW, SW
Lomond	Clay loam	16	N and S E and W	SW
Whitla	Heavy loam	16	N and S	W
Claresholm	Fine sandy loam	13½, 10	N and S	SW, NW
Craigmyle	Loam	16, 13½	E and W	NW, SW
Drumheller	Clay	10, 16, 20	N and S E and W	SW, NW
Nobleford	Silt loam	20	N and S	SW
Pincher Creek	Clay	10	N and S	W

Observations have been recorded by operators on the severity of soil drifting on the substations and in the surrounding districts. During the years 1936-39 medium or severe soil drifting was observed on an average of once per year on each substation; for the period 1940-44 soil drifting was practically negligible; for the years 1945-46 the figure was one and one-half occasions per substation per year. Comparative figures for the districts surrounding the stations for the same three periods are five, two, and seven occasions. In considering these figures, it should be realized that they do not take into consideration the length of time drifting occurred and in some cases drifting reported at different times occurred on the same field. However, the figures indicate the general picture during the past eleven years.

The observations noted above, indicate a very pointed warning that the danger of soil drifting always will face prairie farmers. The reduction in soil drifting during the second period can be attributed to both good weather conditions and improved cultural practices. There was a return to more severe weather conditions in the third period, particularly in the spring of 1946, when on four occasions the wind in the spring exceeded 60 miles per hour. Such conditions taxed soil drifting control practices to the limit.

During the past eleven years, it has been observed repeatedly that soil drifting occurred chiefly on large fallow fields that were not protected adequately by either trash cover or a lumpy soil condition. Stripped fields without similar protection also have drifted.

Emergency Control of Soil Drifting

There have been very few occasions on the substations when emergency methods to control soil drifting have been necessary. Listing has been done in a limited way on a few substations. Late fall ploughing of fallow strips has been done at Nobleford when the trash cover was not considered adequate to protect the soil from drifting.

Cover-Crops For Soil Drifting Control And Pasture

Cover-crops for soil drifting control and for pasturing feeder cattle have attained outstanding success in the Claresholm district. The original purpose of cover-crops was to prevent soil drifting and their use as fall pastures has

been a secondary but important development. The operator of the present substation at Claresholm seeded a small acreage of summerfallow to cover-crop in 1917, and all his fallow land in 1918. It is interesting to note that in 1917, Norman Grier, operator of the former Illustration Station at Macleod, 28 miles south of Claresholm, seeded cover-crops to prevent soil drifting.

Methods of seeding and the suitability of various cereals have been tested at the Claresholm substation and now the practice followed is to seed oats at ¾ to 1 bushel per acre about the end of July with all drills runs open. In a preliminary test of oats varieties none was significantly superior to Victory.

On the light soil areas there has been no significant reduction in the yields of wheat following cover-crops. This is no doubt due to the fact that the moisture used by the cover-crop has been replaced by early spring precipitation.

Farmers naturally turned their stock on cover-crop but it was not until 1937 that commercial pasturing of feeder cattle was started. In that year the Claresholm operator arranged with Calgary cattle dealers to pasture 2,700 head of feeder cattle. Pasturing of feeder cattle has increased until now it is estimated that 45,000 acres are seeded to cover-crop each year and 10,000 to 12,000 head of feeder cattle are pastured on it. Farmers have been paid from 75 cents to $8.00 per head per month for this pasture. In most years 75 per cent of cattle are marketed as finished beef when removed from the cover-crop fields.

Cattle are turned onto the crop when it is 12 to 18 inches high and an acre of such a crop will support a steer for 4 to 5 weeks. At the Claresholm substation in 1944, steers gained 2·8 pounds per day and gains of well over 2 pounds per day are expected under good weather conditions. However, under adverse weather conditions, such as those of 1945 and 1946, gains of 1·1 and 1·2 pounds respectively were obtained. In these two seasons, the worst since 1937, heavy snows remained on the ground for long periods. A number of steers on cover-crop at the Pincher Creek station gained 2·8 pounds per day in the fall of 1946. These steers were marketed immediately after the first, heavy snowfall.

It will be seen that there are hazards connected with pasturing cover-crops but generally speaking, cover-crops in the Claresholm district have been good for both farmers and ranchers. The practice of using these crops can now be found along the foothills from Pincher Creek to High River, but Claresholm is considered the most desirable cover-crop district.

Water Erosion Control

Erosion of the soil by water is not so conspicuous in southern Alberta as erosion by wind. Nevertheless, under certain conditions it can be equally destructive. Water erosion is an ever-present problem in the areas in and immediately east of the Alberta foothills. In these areas rainfall is heavier than on the open prairies. The land is sloping and traversed by waterways varying from shallow draws to deep gullies.

Water erosion control was instituted at Pincher Creek substation in 1936 when contour dykes were constructed to lead run-off water from a shallow draw. Water erosion in the draw was eliminated but there was a certain amount of sheet erosion taking place on the slopes of the field.

A modified system of contour farming was established on this 200-acre field in 1940. Five contour lines were staked across the field and with these as a guide the field was divided into three strips. The centre strip, which includes most of the steep and gravelly parts, contains about 46 acres and was seeded to alfalfa and grasses. The other two strips produced grain, and were fallowed only when the moisture or weed situation indicated the necessity.

Contour farming on a limited scale also has been established on the substations at Nobleford and Drumheller. It is difficult to evaluate the increase in yield due to the change from straight line farming to contour farming. However, it is known that the operators are enthusiastic about contour farming. Water erosion has been controlled completely, wind erosion control is effective, and field operations are performed more conveniently and economically.

Very good results have been obtained in controlling gullying at Pincher Creek and Nobleford by seeding drainageways to brome grass.

Cereals

Rates of Seeding Wheat

Rates of seeding trials have been carried on at all substations. The rates used were: 15, 30, 45, 60, 75, 90, 105, and 120 pounds per acre. Weeds were prevalent in the plots sown at 15 and 30 pounds per acre but were distinctly fewer in the rates of 45 pounds and higher.

The trials indicate that in the eastern part of southern Alberta 50 pounds per acre is a satisfactory rate; in the central part 60 pounds; and in the western part along the foothills 70-75 pounds. The seed used in the tests was plump and of high germination. These factors must be taken into consideration in deciding the rate of seeding.

Testing Cereal Varieties

Testing of cereal varieties has been conducted on the substations in co-operation with the cerealists at the Lethbridge and Swift Current Experimental Stations and the results of these tests are included in their reports.

Seed Distribution

The quality of grain produced in districts surrounding the substations has been improved through the distribution of good seed by operators. The quality of grain produced on the substations is maintained by supplying to operators a limited amount of registered seed of approved varieties. This seed is multiplied on the substations and then is available to neighbouring farmers at a reasonable cost. During the twelve-year period, 1935-46, a total of 78,942 bushels of seed grain has been distributed. The average number of farmers per year availing themselves of this service is one hundred and twenty-five.

The multiplication of Rescue wheat in Alberta, during 1946, was done mainly by substation operators. This variety also was multiplied by eleven other farmers located in districts not served by substations. A total of 31,326 bushels of good seed was produced from 2,101 bushels seeded in the spring. The distribution of this seed in the sawfly areas of southern Alberta was supervised by the Lethbridge Experimental Station and any farmer was given the privilege of obtaining at least 10 bushels at $2.00 per bushel. In southern Alberta, 1,058 farmers bought 14,741 bushels. The balance available, 16,585 bushels, was shipped to Saskatchewan to help meet requirements in the sawfly areas of that province.

Control of Wheat Stem Sawfly

The control of wheat stem sawfly has been a major project on southern Alberta substations since 1939. In that year the substation at Nobleford was established, its principal purpose being to study sawfly control methods. Close co-operation in this work has been maintained with Dr. C. W. Farstad, Dominion Entomological Laboratory, Lethbridge, who planned the work and directed the assembling of data. A certain amount of work also has been conducted on all other substations where sawflies were causing damage.

Extensive trials have been conducted, principally at Nobleford, on the use of trap crops. These have included wheat, spring rye, and oats at various dates and rates of seeding, fertilized and non-fertilized, with and without a bare strip separating the trap from the main crop. In the case of oats different varieties were checked. The most effective temporary trap was found to be wheat seeded at the normal rate about 10 to 12 days before the main crop, and separated from the main crop by a bare strip about 12 feet wide.

Brome was found to be the most desirable permanent trap crop.

The time to cut all traps was found to be just after egg laying was completed.

Various methods of cultural control were tested, aimed at throwing larvae-infested stubs on the surface where they would be exposed to hot, drying winds. No suitable method was found due to the difficulty of obtaining suitable weather conditions and of exposing a large enough percentage of infested stubs.

A practical and effective method of controlling the pest, and one that has been used extensively on the substations, is the practice of seeding relatively immune crops such as oats, barley, and flax on the strips of a part of the farm and seeding wheat on the alternate strips the following year. The rotation: fallow-wheat-flax has given satisfactory results at Nobleford.

The introduction of the sawfly-resistant variety of wheat, Rescue, facilitated the control of sawfly on the substations in 1946. With very few exceptions, reports on the performance of Rescue have been satisfactory.

Sawfly damage has not been serious on the substations because available control measures, even if not perfect, were instituted while infestations still were light.

Cereal Hay Tests

Tests with cereals for hay production have been conducted for seven years. In the higher-rainfall areas represented by Pincher Creek and Claresholm, oats are the most satisfactory hay crop. Where drier conditions prevail, wheat, oats, barley, spring rye, and fall rye grown on fallow have yielded an average of 2 tons per acre with not less than 1 ton per acre in any year. When grown on stubble the average was one ton per acre and in some years the crop was not worth cutting. Spring rye has outyielded other cereals in unfavourable years and this cereal has been grown extensively for feed on the low-rainfall substations at Whitla, Acadia Valley, and Lomond.

The Farm Business

The successful farm business is based on many factors and perhaps the most important principle involved is that farming practices should suit the conditions found in each particular area. In other words, the farmer should "farm with the district rather than against it".

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

Land Utilization

The use of land gives an indication of the type of farming being followed. Southern Alberta substations represent phases of agriculture that suit very well the particular conditions found in each district. Table 39 shows the use of land in 1946 on the various substations.

TABLE 39.—UTILIZATION OF LAND ON SOUTHERN ALBERTA SUBSTATIONS—1946

Station	Total area*	Cultivated Land	Native and Imp. Pasture	Cultivated Land		
				Wheat	Other Crops	Fallow
	acres	acres	acres	acres	acres	acres
Acadia Valley	6,880	1,086	5,780	318	260	508
Bindloss	480	442	25	223	.....	219
Foremost	880	868	.....	497	.....	317
Lomond	800	664	130	274	58	332
Whitla	1,920	762	1,150	280	192	290
Claresholm	1,568	918	646	408	80	430
Craigmyle	1,280	1,067	207	490	56	521
Drumheller	3,032	1,558	1,186	720	178	660
Nobleford	480	457	15	258	22	177
Pincher Creek	1,014	590	364	257	241	92
Average	1,833·4	841·2	950·3	372·5	108·7	360·0
				44·3%	12·9%	42·8%

* Total area includes farmstead and waste land which are not included in the two sub-divisions of land shown.

Southern Alberta substations are situated on the open prairies and it is not surprising that the greater part of the cultivated land is devoted to wheat production and to a large extent wheat is grown on summerfallow. The acreage in crops other than wheat is devoted largely to the production of barley, oats, and rye. The stations at Acadia Valley, Lomond, and Whitla have seeded spring rye and fall rye for feed for many years.

The acreage in pasture reflects the extent of the livestock maintained on the station. Acadia Valley raises beef cattle on range land of relatively low carrying capacity. Drumheller has an important livestock enterprise. There is an excellent herd of grade Herefords at Pincher Creek where the carrying capacity of the pasture is quite high. The pasture at Claresholm is used at present for feeder cattle which are finished on cover-crop in the fall.

Farm Capital

Inventory records for 1946 show that the average investment in land and buildings is 62·3 per cent; in livestock 12·6 per cent; and in machinery 25·1 per cent. A summary showing the distribution of capital on individual substations is presented in Table 40.

There is a considerable investment in livestock at many substations and this is to be expected in order that effective use can be made of the pasture available.

TABLE 40.—DISTRIBUTION OF FARM CAPITAL ON SOUTHERN ALBERTA SUBSTATIONS

Substations	Land and Buildings	Live-stock	Machin-ery and Equip-ment	Total
	%	%	%	%
Acadia Valley	38·9	39·1	22·0	100·0
Bindloss	54·4	2·2	43·4	100·0
Foremost	78·9	0·1	21·0	100·0
Lomond	60·4	10·7	28·9	100·0
Whitla	59·6	13·8	26·6	100·0
Claresholm	65·6	21·2	13·2	100·0
Craigmyle	58·4	8·5	33·1	100·0
Drumheller	71·6	13·5	14·9	100·0
Nobleford	73·5	1·1	25·4	100·0
Pincher Creek	61·9	15·9	22·2	100·0
Average	62·3	12·6	25·1	100·0

The investment in machinery and equipment varies from 13·2 to 43·4 per cent of the total investment. The actual investment in machinery per cultivated acre averages $10.58 with a variation from $5.77 at Drumheller to $17.07 at Nobleford. The effective use of machinery and equipment is greatly influenced by the size of farm. The highest investments per acre are on the stations at Bindloss and Nobleford where farm acreage at each is 480 acres. This is a considerably lower acreage than the average of 841·2 cultivated acres for all substations.

Sources of Revenue

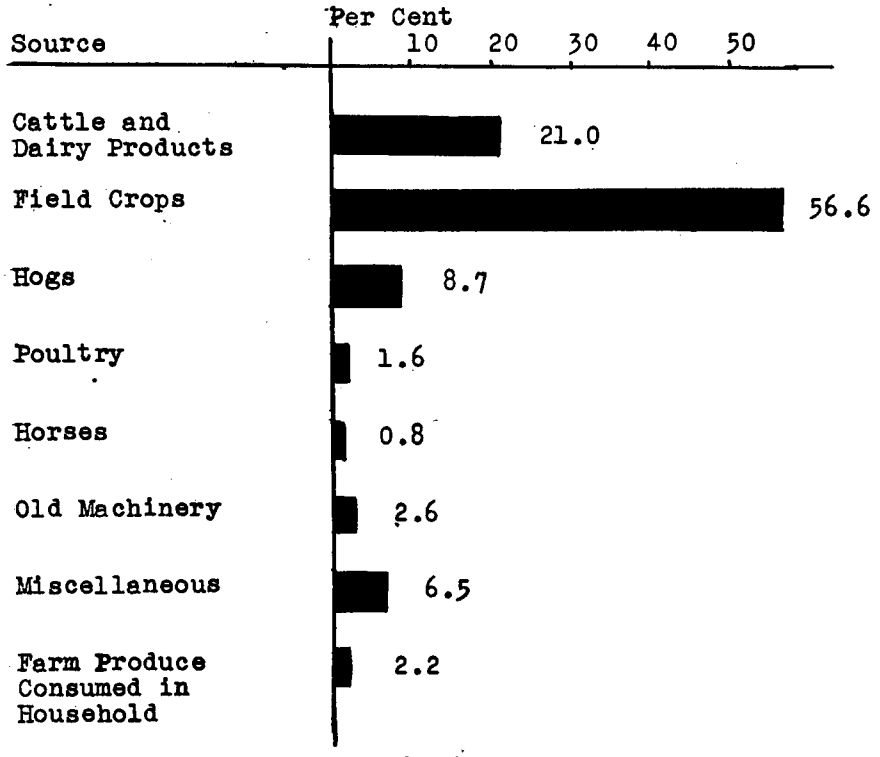
A summary of revenue received from various sources is drawn up as of December 31 of each year. Average receipts for the five-year period 1942-46 are summarized in the following chart. (p. 78).

Operators received 56·6 per cent of their total revenue from field crops during the five-year period 1942-46. Livestock, almost wholly beef cattle, contributed 21 per cent with a high of 28·5 per cent in 1946. Only sufficient dairy cows are maintained at the substations to supply the needs of the household. During this five-year period hogs accounted for 8·7 per cent of the total revenue. Revenue from this source has decreased from a high of 14·3 per cent in 1943 to 10·4 per cent, 5·6 per cent, and 4·3 per cent in the succeeding three years. Miscellaneous revenue, made up largely from receipts from custom work, produced 6·5 per cent. Farm produce used in the household is considered income and this source accounts for 2·2 per cent. Other items making up the total revenue in this five-year period are, poultry 1·6 per cent, horses 0·8 per cent, and old machinery 2·6 per cent.

Yields and Cost of Producing Wheat

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

SOURCES OF REVENUE DISTRICT EXPERIMENT SUBSTATIONS SOUTHERN ALBERTA—1942-1946 INCLUSIVE.



Many farmers have been paying high prices recently for custom work but the price paid cannot be taken as a reliable guide to the actual cost of farm operations. The data presented give a fairly good estimate of costs on the individual substations, where the work is done mainly by the farmer himself. They also are of interest when comparisons are made between substations.

Since the greater acreage of wheat in southern Alberta is grown on fallow the cost of fallowing and the cost of growing wheat on fallow are presented in Tables 41 and 42.

In the data on cost of fallowing shown in Table 41, besides the costs of various field operations, a charge is included for use of land, taxes, machinery, man labour, general farm expense, and management.

TABLE 41.—COST PER ACRE TO SUMMERFALLOW LAND—1946 AND AVERAGE

Substation	Use of Land and Taxes	Use of Machinery	Gas, Oil, Grease	Man Labour	General Farm Exp.	Management	Less Value of Cover-Crop	Total Cost per Acre	Average	
									Years	Cost
	$	$	$	$	$	$	$	$	No.	$ cts.
Acadia Valley	0·96	0·49	0·63	0·31	0·26	0·23	.....	2·88	7	2·90
Bindloss	0·64	0·36	0·35	0·24	1·08	0·23	.....	2·90	9	2·13
Foremost	1·19	0·43	0·33	0·26	0·72	0·52	.....	3·45	9	2·37
Lomond	1·05	0·46	0·36	0·26	0·71	0·38	.....	3·22	9	2·64
Whitla	0·77	0·34	0·26	0·19	0·35	0·32	.....	2·23	9	1·94
Claresholm	2·25	0·44	0·32	0·28	1·58	1·20	4·05	1·02	9	1·74
Craigmyle	1·23	0·75	0·24	0·30	0·71	0·45	.....	3·68	7	3·30
Drumheller	1·34	0·53	0·43	0·35	0·37	0·32	.....	3·85	7	2·73
Nobleford	2·63	0·87	0·75	0·47	1·95	1·84	.....	8·51	7	5·87
Pincher Creek	2·60	1·01	0·97	0·58	1·35	1·44	4·17	3·78	9	4·64

A credit for the net value of cover-crops has been given at Claresholm and Pincher Creek. Cover-crops are always seeded on fallow at Claresholm but only occasionally at Pincher Creek.

There is a wide variation in the cost of summerfallowing at the different substations. Land in the higher productive areas such as Claresholm, Nobleford, and Pincher Creek has a high value and hence the charge for its use is high. Taxes in these areas are higher than in the less productive districts. Usually more operations are necessary to make a good fallow in areas of higher rainfall where weed growth is greater. The cost of performing the same operation on different stations varies greatly. Some of the factors involved are soil texture, moisture conditions of the soil, size of implement, kind and size of tractor, kind of fuel and the interest charge on machinery investment which is based on the number of hours of work done each year.

The cost of summerfallowing is a definite charge against succeeding crops. Where wheat alternates with fallow the whole cost of fallowing is charged to the succeeding wheat crop. When two crops follow the fallow, two-thirds is charged to the first crop and one-third to the second.

Yields have been recorded and cost of producing wheat have been calculated for the substations for a number of years. Costs involved in producing wheat include charges for use of land, taxes, cost of fallowing the previous year, seed, field operations, hauling to elevator, use of buildings, hail insurance, management, general farm expenses, and interest on net cost. Table 42 presents the average cost of growing wheat for a period of years.

TABLE 42.—SUMMARY OF YIELDS AND COST OF PRODUCTION OF WHEAT AFTER FALLOW

SOUTHERN ALBERTA SUBSTATIONS

Station	No. Years Grown	Yield per Acre Average	Cost per Acre Average	Cost per Bushel Average
		bus.	$	$
Acadia Valley	8	24·2	8·31	0·34
Bindloss	12	14·1	7·18	0·51
Foremost	10	14·0	7·53	0·54
Lomond	12	14·0	8·30	0·59
Whitla	12	8·7	6·33	0·73
Claresholm	10	21·4	9·64	0·45
Craigmyle	8	21·9	9·52	0·43
Drumheller	10	19·0	9·63	0·51
Nobleford	8	31·3	14·90	0·48
Pincher Creek	12	31·1	14·82	0·48

Yield is perhaps the most important factor in determining the cost of production but it will be noticed that the cost of production is not lowest where highest yields are obtained. The yield at Acadia Valley was 7·1 bushels lower than at Nobleford but the cost per bushel was 34 cents as compared with 48 cents. The cost of production per acre on the high value land at Nobleford was almost twice that at Acadia Valley. This bears out the opinion of many farmers that, with good farming practices, farmers on the good soils of the drier areas can produce wheat as cheaply, if not more cheaply, than farmers on high priced land in areas of higher precipitation.

MISCELLANEOUS PROJECTS

Water Development

Operators of substations have realized the value of adequate water storage facilities for both domestic and livestock use. At the end of 1946 there were six dams and six dugouts on nine substations. Water from dugouts at Nobleford, Foremost and Drumheller is used to irrigate the farm garden.

Farm Shelterbelts

Farm shelterbelts were planted shortly after the substations were established with most of the planting being done during the period 1936-39. A total of 18,225 broad-leaved trees, 2,615 evergreens, and 17,605 caragana were planted up to 1939, and a small number of replacements has been planted since. The broad-leaved trees are largely green ash and elm with a smaller number of northwest poplar and maple. White spruce is the variety of evergreen planted.

The shelterbelts were fenced, where necessary, to protect them from livestock, and a 16-foot strip was left for cultivation between the belt and the fence. By keeping a 16-foot strip free from all growth an additional supply of moisture has been made available for the trees.

In recent years there has been a tendency for grass, particularly crested wheat grass, to become established in the shelterbelts. The operator at Nobleford has been careful to mow crested wheat grass near his tree plantings before the grass matured seed and this belt is completely free from all grass growth.

The Farm Garden

The growing of a good vegetable garden is dependent on many factors including weather conditions, seed-bed preparation, suitable varieties, and protection from the wind. In most cases the shelterbelts on the substations have made sufficient growth to give protection to the farm garden.

Weather conditions vary from year to year but in most years the farm gardens have produced satisfactory crops. The application of water from dugouts at Nobleford, Foremost, and Drumheller has contributed greatly to the success at those points. Water from a well has been pumped on the garden at Craigmyle. Plans are under way at Pincher Creek to irrigate from a shallow well.

Varieties of vegetables grown are those recommended by the Experimental Station, Lethbridge and listed in the Horticulture section of this report.

Beef Production

The production of beef cattle is an important source of revenue at five substations. At the end of 1946 the number of beef females in breeding herds were: Acadia Valley—60, Drumheller—32, Pincher Creek—34, Whitla—12. The Claresholm station had 135 head of feeder cattle on cover-crop. With the exception of Drumheller, where the breed is Aberdeen Angus, all beef cattle are grade Hereford of good quality.

Cattle on all stations are treated for warble flies, the large herds by means of a power sprayer and the small herds by hand. The operators at Pincher Creek and Claresholm have been influential in promoting warble fly control in their districts.

Poultry Production

With the exception of Pincher Creek, where New Hampshire poultry are raised, the breed of poultry kept on the stations is Barred Plymouth Rock. In the earlier years operators sold hatching eggs and cockerels to improve the quality of poultry in their districts. The parent stock was obtained from the Lethbridge Experimental Station. However, in recent years farmers have bought baby chicks rather than hatch their own, and consequently the demand for hatching eggs and cockerels has decreased greatly. Since 1935, operators sold to their neighbours 2,876 dozen hatching eggs and 509 cockerels for breeding purposes.

Swine Production

The raising of swine has been carried on chiefly at Pincher Creek and Drumheller and at the end of 1946 only a few breeding sows of the Yorkshire breed were being kept as a nucleus for future expansion.

Since 1938, a total of 126 gilts and boars have been sold for breeding purposes.

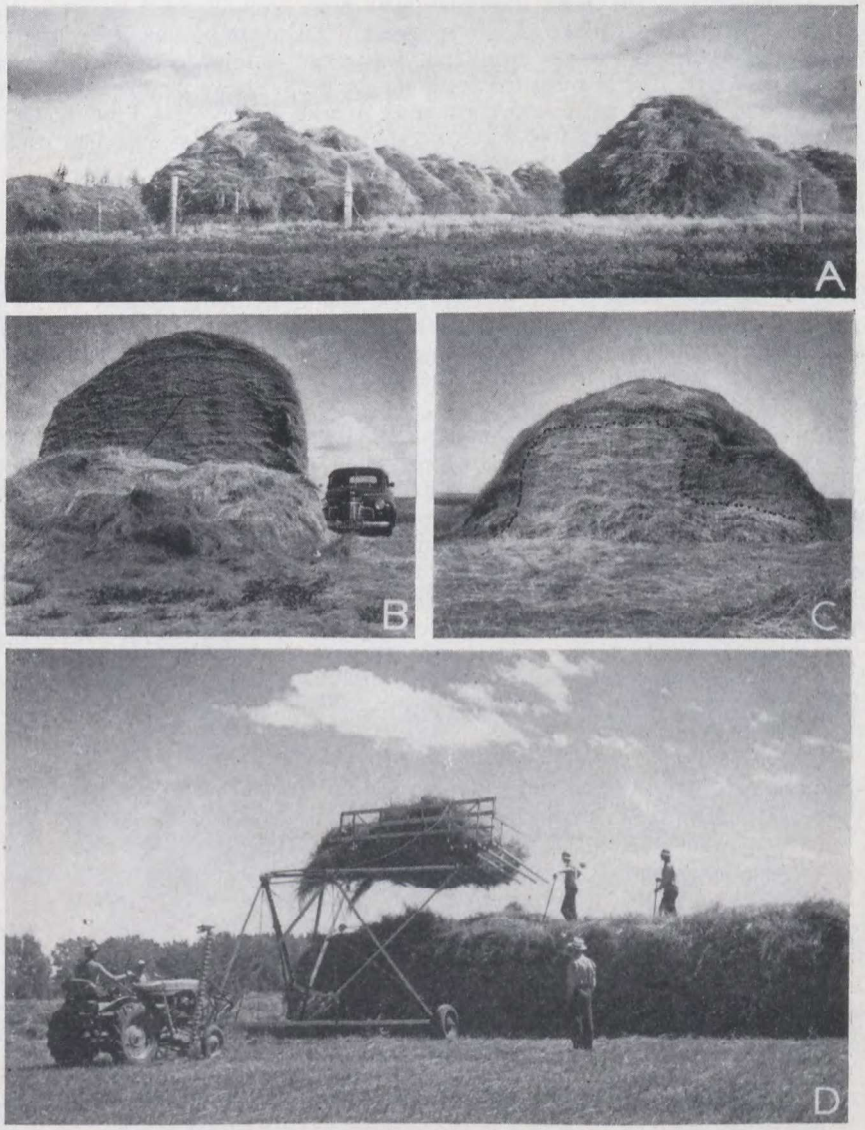


PLATE VIII—AN AMPLE FEED RESERVE IS WISE INSURANCE.

A. Feed reserves on hand at the Acadia Valley District Experiment Substation.
B. A high stack, with a solid centre, sheds water and may be kept for years with little spoilage.
C. This stack is too low and flat to shed water. The depth of moisture penetration and spoilage is indicated by the dotted line.
D. Good stacks, with adequate height, may be built at minimum cost with efficient equipment.

Feed Reserves

Conditions in southern Alberta require that feed reserves of hay and straw be maintained on those substations where appreciable numbers of cattle are maintained. Usually cattle can graze on range lands and stubble fields for part of the winter but frequently it is necessary for cattle to be fed for fairly long periods. Some districts have short crops and failures more frequently than others so substations in those districts must have greater feed reserves than where the risk of crop failure is not so great. An attempt has been made to have hay and straw reserves of from 1 to 3 tons per animal in the fall, depending on the district. Cattle were fed for a longer period than usual in the winter of 1946-47 and reserves were drawn upon at Acadia Valley and Pincher Creek. Some of these reserves were five and six years old but were of excellent quality because they had been stored in properly built stacks.

Field Days

Field days have been held annually at all substations, since they were established in 1935, to acquaint farmers with the work being conducted on the substations and on the Experimental Farms. Officials of the Dominion and Provincial Departments of Agriculture have co-operated to present interesting and instructive programs which over the years have covered practically every phase of agriculture.

Programs have consisted of short talks followed by an inspection of some phase of work being conducted at the substation. A special talk for the ladies has been a feature of each field day for many years. Moving pictures also have been used to illustrate farming practices.

Farmers have shown their interest in field days by their increasing attendance. The average attendance for each field day held in 1935, 1936, and 1937 was 44, 65, and 105 respectively. From 1938 to 1946 the general average was 157.

PUBLICATIONS

Detailed data and discussions on various phases of the work at the Station have been made available in bulletins and technical papers from time to time.

Soil Erosion

Organized methods of soil drifting control. A. E. Palmer, C.S.T.A. Review 23: 35-37, 1939.

Soil drifting control in the Prairie Provinces. E. S. Hopkins, A. E. Palmer, and W. S. Chepil, Dominion of Canada Dept. of Agricultre Farmers' Bulletin 32, Revised 1946.

Cultural practices for the control of wind erosion of soils in Western Canada. A. E. Palmer, The Empire Journal of Experimental Agriculture 13: 125-134, 1945.

Irrigation

Irrigation development for resettlement. W. H. Fairfield and G. N. Denike, C.S.T.A. Review 23: 64-67, 1939.

Possibilities for settlement on irrigated lands in Alberta. A. E. Palmer, Scientific Agriculture 23: 200-204, 1942.

Use of irrigation water on farm crops. A. E. Palmer, Dominion of Canada Department of Agriculture Farmers' Bulletin 10, Revised 1939.

Changes in the nature and position of the soluble salts in certain Alberta soils after twenty years of irrigation. J. B. Marshall and A. E. Palmer, Scientific Agriculture 19: 271-278, 1939.

Sugar Beet Production

Summary of results of fertilizer tests conducted for the last eight years at the Dominion Experimental Station, Lethbridge, Alberta, Canada. A. E. Palmer, Proceedings, First General Meeting, American Society Sugar Beet Technologists, 31-32, 1938.

The storage of beets between the time of harvesting and slicing in southern Alberta, Canada. A. E. Palmer, Proceedings, Third General Meeting, American Society Sugar Beet Technologists, 46-51, 1940.

Yield, percentage of sucrose and coefficients of apparent purity of sugar beets as affected by rotational, manurial and fertilizer practices at the Dominion Experimental Station, Lethbridge, Alberta. K. W. Hill, Proceedings, Fourth General Meeting, American Society of Sugar Beet Technologists, 63-72, 1946.

Standard methods of laboratory germination of sugar beet seed in Canada. K. W. Hill, Proceedings, Fourth General Meeting, American Society of Sugar Beet Technologists, 283-284, 1946.

Forage

Haymaking with crested wheat grass in the dry areas of Alberta. R. W. Peake and H. Chester, Dominion of Canada Department of Agriculture Farmers' Bulletin 119, 1943.

Grazing surveys and regrassing program, S. E. Clarke, G. D. Matthews, and R. W. Peake, C.S.T.A. Review 23: 43-48, 1939.

Livestock

Lamb feeding in southern Alberta. W. H. Fairfield and K. Rasmussen, Dominion of Canada Department of Agriculture Farmers' Bulletin, 1, 1936.

Feedlot finishing of cattle and sheep in the irrigated areas of Southern Alberta. F. Whiting, Dominion of Canada Department of Agriculture Farmers' Bulletin 140, 1947.

Review of some range sheep breeding projects in Canada. K. Rasmussen, Empire Journal of Experimental Agriculture 13: 213-223, 1945.

The effect of breeding on feedlot performance and carcass characteristics of lambs as determined by feeding trials and carcass tests. K. Rasmussen and J. A. Weir, Scientific Agriculture 21: 153-166, 1940.

The reproductive capacity of breeds of range sheep. K. Rasmussen, Scientific Agriculture 22: 11-17, 1941.

A note on the effect of multiple births on the sex ratio in sheep. K. Rasmussen, Scientific Agriculture 21: 759-760, 1941.

A new lethal in sheep. K. Rasmussen, Scientific Agriculture 25: 482-488, 1945.

The inheritance of fleece weights in range sheep. K. Rasmussen, Scientific Agriculture 23: 104-116, 1942.

Numerous mimeograph circulars also have been prepared from time to time dealing with special subjects on which information was in general demand.

APPENDIX

TABLE 43.—MONTHLY AND ANNUAL AVERAGE OF DAILY MAXIMUM TEMPERATURES

RECORDED BY THE DOMINION METEOROLOGICAL SERVICE AT REPRESENTATIVE POINTS IN SOUTHERN ALBERTA

Station	Years Observed	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Average for April-Sept.	Oct.	Nov.	Dec.	Year
Cardston	23	26	31	40	53	62	70	79	75	64	67·2	56	42	30	52
Raymond	15	27	31	41	53	65	72	80	78	66	69·0	56	41	33	54
Foremost	15	22	23	37	53	67	74	83	79	66	70·3	59	36	30	52
Pincher Creek	35	27	30	38	51	60	67	75	73	62	64·6	53	39	31	51
Macleod	38	27	30	39	55	64	72	80	77	66	69·0	57	40	32	53
Lethbridge	30	27	31	40	55	64	72	78	77	66	68·7	56	42	31	53
Medicine Hat	55	22	25	39	58	68	76	84	81	69	72·7	58	37	29	54
Calgary	55	24	28	37	53	63	69	76	74	64	66·5	54	38	29	51
Strathmore	25	21	26	35	52	63	70	77	74	63	66·5	53	38	24	50
Gleichen	35	21	25	36	53	64	71	78	75	65	67·7	54	38	26	51
Bassano	20	23	28	38	54	66	74	81	78	66	69·7	55	39	25	52
Brooks	23	20	25	38	56	66	75	82	79	67	70·8	56	38	25	52
Jenner	20	17	24	35	52	67	74	82	80	68	70·5	55	35	22	51
Hanna	18	16	23	32	51	63	71	77	75	64	66·8	53	36	18	48
Alsask	16	17	20	33	52	65	74	81	78	65	69·2	54	35	20	50

TABLE 44.—MONTHLY AND ANNUAL AVERAGE OF DAILY MINIMUM TEMPERATURES

RECORDED BY THE DOMINION METEOROLOGICAL SERVICE AT REPRESENTATIVE POINTS IN SOUTHERN ALBERTA

Station	Years Observed	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Average for April-Sept.	Oct.	Nov.	Dec.	Year
Cardston	23	7	11	20	29	38	45	50	47	39	41·3	32	22	11	29
Raymond	15	7	9	20	29	40	47	51	48	39	42·3	32	20	15	30
Foremost	15	2	0	14	30	41	48	53	49	38	43·2	32	16	12	28
Pincher Creek	35	9	11	18	28	37	43	48	46	39	40·2	33	22	14	29
Macleod	38	6	9	17	30	39	46	51	49	41	42·6	34	21	14	30
Lethbridge	30	5	8	17	29	38	46	50	48	39	41·6	31	20	11	28
Medicine Hat	55	2	4	17	32	42	50	55	52	43	45·6	33	19	10	30
Calgary	55	2	6	14	27	36	43	47	45	37	39·2	29	17	9	26
Strathmore	25	−1	4	14	27	36	44	48	46	37	39·6	27	16	5	25
Gleichen	35	−1	3	14	27	36	44	50	46	36	39·8	27	15	4	25
Bassano	20	2	6	15	29	40	48	52	50	40	43·2	30	18	6	28
Brooks	23	−2	1	14	28	38	47	52	48	38	41·8	29	14	5	26
Jenner	20	−5	3	14	30	39	48	52	48	37	42·3	28	14	2	26
Hanna	18	−3	5	13	28	38	46	50	47	37	41·0	28	17	1	26
Alsask	16	−4	−1	11	27	38	46	51	47	38	41·2	27	13	−1	24

TABLE 45.—AVERAGE ANNUAL AND MONTHLY PRECIPITATION IN INCHES

RECORDED BY THE DOMINION METEOROLOGICAL SERVICE AT REPRESENTATIVE POINTS IN SOUTHERN ALBERTA

Station	Years Observed	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Average for April-Sept.	Oct.	Nov.	Dec.	Year
Cardston	23	1·04	0·56	1·17	1·27	2·80	3·43	1·91	1·79	2·16	12·09	1·31	0·91	0·98	19·33
Raymond	15	0·72	0·65	1·11	1·69	1·68	2·76	1·58	1·03	1·59	8·64	0·87	0·88	0·83	15·39
Foremost	15	.....	.....	.....	1·53	1·88	2·81	1·61	1·88	1·69	9·87	0·44	.....	.....	.....
Pincher Creek	35	0·84	0·92	1·29	1·54	2·67	3·29	2·28	2·05	1·95	12·24	1·39	0·93	0·86	20·01
Macleod	38	0·73	0·62	0·92	0·82	1·88	2·83	1·86	1·58	1·52	9·67	0·82	0·76	0·66	15·00
Lethbridge	30	0·58	0·65	0·93	1·20	1·85	2·67	1·60	1·48	1·51	9·11	1·02	0·77	0·75	15·01
Medicine Hat	56	0·63	0·57	0·63	0·77	1·61	2·42	1·68	1·36	1·13	8·20	0·62	0·69	0·70	12·81
Calgary	55	0·51	0·55	0·84	0·99	2·34	3·14	2·51	2·29	1·50	11·78	0·69	0·72	0·57	16·65
Strathmore	25	0·41	0·52	0·66	1·05	2·02	3·04	1·93	2·00	1·40	10·39	0·85	0·62	0·47	14·97
Gleichen	35	0·57	0·59	0·64	1·28	1·77	2·35	2·08	1·70	1·04	8·94	0·69	0·59	0·60	13·90
Bassano	20	0·59	0·53	0·67	1·22	2·16	1·78	2·06	1·32	1·35	8·67	0·54	0·58	0·77	13·57
Brooks															
Jenner	20	0·69	0·51	0·52	1·03	1·56	1·64	1·42	1·22	1·23	7·07	0·73	0·71	0·89	12·15
Hanna	18	0·48	1·35	0·52	1·17	1·72	2·90	2·56	1·46	0·90	9·54	0·58	0·74	0·77	14·15
Alsask	16	0·62	0·33	0·77	1·11	1·70	1·50	1·59	1·24	0·95	6·98	0·90	0·73	0·60	12·04

TABLE 46.—MONTHLY PRECIPITATION RECORDED AT LETHBRIDGE DURING THE PERIOD 1902-1946

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

TABLE 47.—SUMMARIES OF TEMPERATURE, SUNSHINE, WIND, EVAPORATION AND PRECIPITATION DATA

RECORDED AT LETHBRIDGE, ALBERTA

Month	Temperature			Sunshine		Wind					Evaporation	Precipitation
	45-Year Average			38-Year Average		Mean Hourly Velocity (M.P.H.) 26-Year Average	Mean Monthly Mileage 26-Year Average	Greatest Mileage in One Hour			In Inches 25-Year Average	45-Year Average
	Average of Highest for Month	Average of Lowest for Month	Mean for Month	Average Total Hours for Month	Average Total Hours for Day			Mileage	Direction	Date		
January	52·1	−24·1	17·4	98·9	3·19	13·4	9,982	72	SW	14–1921	.....	0·63
February	54·6	−23·7	19·0	122·5	4·34	12·3	8,366	68	SW	7–1945	.....	0·69
March	63·0	−10·5	28·8	162·1	5·23	12·6	9,399	63 63	W SW	24–1925 24–1943	.....	0·85
April	75·8	11·4	42·1	211·6	7·05	13·0	9,365	65	SW	26–1946	.....	1·12
May	82·4	25·4	50·9	256·7	8·26	11·8	8,784	62	SW	6–1939	4·70	2·32
June	86·9	34·8	58·3	280·3	9·34	10·3	7,392	58	W	23–1943	4·74	2·76
July	92·9	40·3	64·6	340·9	10·98	8·9	6,608	57	SW	11–1942	6·14	1·73
August	91·2	36·8	62·3	300·1	9·68	8·6	6,371	53	SW	9–1944	5·09	1·53
September	84·0	25·8	53·3	206·7	6·89	9·7	6,749	58	W	19–1944	3·43	1·72
October	77·8	13·7	44·6	167·4	5·40	12·1	9,020	61	W	10–1941	2·40	0·97
November	63·6	− 7·8	31·2	110·7	3·69	12·7	8,950	83	SW	24–1941	.....	0·81
December	54·7	−20·0	22·0	94·0	3·03	13·8	10,328	63	SW	12–1924	.....	0·69
Yearly Totals	.....	.....	.....	2,351·9	.....	.....	101,314	.....	.....	.....	.....	15·83
Monthly Averages	.....	.....	41·3	196·0	6·42	11·5	8,443	.....	.....	.....	.....	.....

TABLE 48.—FROST DATA

DOMINION EXPERIMENTAL STATION, LETHBRIDGE, ALBERTA

Year	Last Frost in Spring		First Frost in Fall		No. of Frost Free Days	Last Killing Frost in Spring		First Killing Frost in Fall		No. of Crop Days
	Date	Temp.	Date	Temp.		Date	Temp.	Date	Temp.	
		°F		°F			°F		°F	
1902	May 9	32·0	Aug. 29	31·9	112	April 25	20·5	Sept. 20	27·5	148
1903	May 22	29·6	Sept. 13	31·1	114	May 21	26·0	Sept. 30	26·5	132
1904	May 25	29·9	Sept. 13	27·1	111	April 18	25·0	Sept. 13	27·1	148
1905	May 19	32·0	Sept. 30	28·8	134	May 5	28·0	Oct. 10	24·8	158
1906	May 27	32·0	Aug. 25	31·2	90	May 8	28·0	Oct. 21	23·0	116
1907	May 13	23·0	Sept. 11	31·9	121	May 13	23·0	Sept. 13	24·2	123
1908	May 2	32·0	Sept. 23	32·0	144	April 30	26·5	Sept. 26	19·2	149
1909	May 29	29·8	Aug. 28	29·8	91	May 8	25·4	Sept. 14	26·8	129
1910	June 4	31·6	Aug. 23	31·5	80	May 20	27·4	Sept. 12	26·3	115
1911	May 28	29·6	Aug. 27	29·4	91	May 1	25·2	Sept. 23	26·3	145
1912	June 6	28·3	Sept. 15	23·9	101	May 4	24·5	Sept. 15	23·9	134
1913	May 12	29·2	Sept. 12	32·0	123	May 6	24·8	Sept. 24	26·2	141
1914	May 12	29·8	Sept. 15	31·0	126	May 11	24·1	Oct. 7	20·1	149
1915	May 16	30·8	Sept. 11	31·2	118	April 11	28·0	Sept. 12	26·5	154
1916	May 23	31·6	Sept. 14	31·2	114	May 13	25·0	Sept. 28	24·0	138
1917	June 4	31·0	Sept. 1	32·0	89	May 30	28·0	Sept. 29	27·0	122
1918	June 6	32·0	Sept. 15	28·0	101	May 26	21·0	Sept. 15	28·0	112
1919	June 1	31·0	Sept. 26	32·0	117	May 14	27·0	Sept. 29	26·0	138
1920	June 3	29·0	Sept. 19	30·0	108	May 30	26·0	Sept. 26	24·0	119
1921	May 31	30·0	Sept. 9	32·0	101	May 28	24·0	Sept. 15	28·0	110
1922	May 23	29·0	Oct. 2	32·0	132	May 6	28·0	Oct. 11	21·0	158
1923	May 29	29·5	Sept. 11	29·0	105	May 15	28·0	Sept. 22	25·0	130
1924	May 26	31·5	Sept. 20	28·5	117	May 6	25·5	Sept. 26	26·0	143
1925	May 17	30·0	Sept. 20	25·5	126	May 11	24·0	Sept. 20	25·5	132
1926	June 9	32·0	Sept. 11	30·0	94	May 2	28·0	Sept. 20	26·0	141
1927	May 18	32·0	Sept. 8	32·0	113	May 9	26·0	Sept. 26	29·0	140
1928	May 14	31·0	Aug. 14	31·0	92	April 22	28·0	Sept. 8	26·0	139
1929	May 19	32·0	Sept. 6	28·0	110	May 15	24·0	Sept. 6	28·0	114
1930	May 23	32·0	Sept. 23	32·0	123	April 21	29·0	Oct. 15	17·0	177
1931	May 21	32·0	Sept. 14	32·0	116	May 19	28·0	Sept. 23	25·0	127
1932	May 28	31·0	Sept. 3	32·0	98	May 15	29·0	Sept. 21	29·0	129
1933	May 20	30·0	Sept. 24	32·0	127	April 20	20·0	Sept. 26	27·0	159
1934	May 12	32·0	Sept. 14	29·0	125	May 2	28·0	Sept. 20	21·0	141
1935	May 28	32·0	Sept. 26	21·0	121	May 8	26·0	Sept. 26	21·0	141
1936	April 29	31·0	Sept. 14	32·0	138	April 28	22·0	Oct. 1	23·0	156
1937	May 21	32·0	Sept. 24	30·8	126	May 6	25·1	Oct. 5	27·1	152
1938	May 15	30·4	Oct. 14	27·8	152	May 14	29·0	Oct. 14	27·8	153
1939	May 1	31·2	Sept. 25	32·0	147	April 20	26·3	Sept. 29	29·0	162
1940	April 26	30·0	Oct. 14	23·0	171	April 19	18·0	Oct. 14	23·0	176
1941	May 22	30·0	Sept. 8	29·5	109	May 8	27·5	Sept. 25	26·8	140
1942	May 18	27·2	Sept. 18	28·0	123	May 18	27·2	Sept. 18	28·0	123
1943	June 8	32·0	Sept. 2	31·2	86	May 14	24·0	Oct. 14	28·0	153
1944	May 23	31·0	Sept. 19	30·5	120	May 7	28·0	Sept. 30	27·8	147
1945	May 12	32·0	Sept. 17	32·0	128	May 8	27·0	Sept. 24	30·0	139
1946	May 21	30·5	Sept. 23	25·0	125	May 10	16·0	Sept. 23	25·0	136
45-Year Average—	May 21 ± 2 days		Sept. 14 ± 2 days		116± 3 days	May 8 ± 2 days		Sept. 26 ± 1 day		141± 2 days
	*S.D. = ± 10 days		S.D. = ± 11 days		S.D. = ±19 days	S.D. = ± 11 days		S.D. = ± 9 days		S.D. = ±16 days
	(May 11–May 31)		(Sept. 3–Sept. 25)			(April 27–May 19)		(Sept. 17–Oct. 5)		

*Standard deviation

TABLE 49—DATA AS TO LAST FROST OF SPRING, FIRST FROST OF FALL AND LENGTH OF CROP SEASON

Dominion Experimental Station,
Lethbridge, Alberta
1902-1946 Inclusive

SUMMARY TO 1946

Latest last frost of spring, June 9, 1926—32°	Earliest last frost of spring, April 26, 1940—30°
Earliest first frost of fall, Aug 14, 1928—31°	Latest first frost of fall, Oct. 14, 1938—27·8°; Oct. 14, 1940—23°
Shortest frost-free season, 1910—80 days.	Longest frost-free season, 1940—171 days.
Latest late killing frost of spring, May 30, 1917—28°: May 30, 1920—26°	Earliest last killing frost of spring, April 11, 1915—28°
Earliest first killing frost of fall, Sept. 6, 1929—28°	Latest first killing frost of fall, Oct. 21, 1906—23°
Shortest crop season, 1921—110 days.	Longest crop season, 1940—178 days.

Note: 1. 32·0° or less considered as frost.
2. 28·0° or less considered as killing frost except when observer's notes indicate otherwise.

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