CANADA
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS SERVICE

ILLUSTRATION STATIONS DIVISION

CENTRAL EXPERIMENTAL FARM, OTTAWA

A. E. BARRETT, M.Sc., CHIEF

PROGRESS REPORT

1948-1953

Fertilizer plots on the Gray Wooded Soils Substation, Loon Lake, Saskatchewan. Effect of sulphur at 20 pounds per acre is indicated by lush green growth of cereals on plots at left. Results are discussed in detail on page (17).

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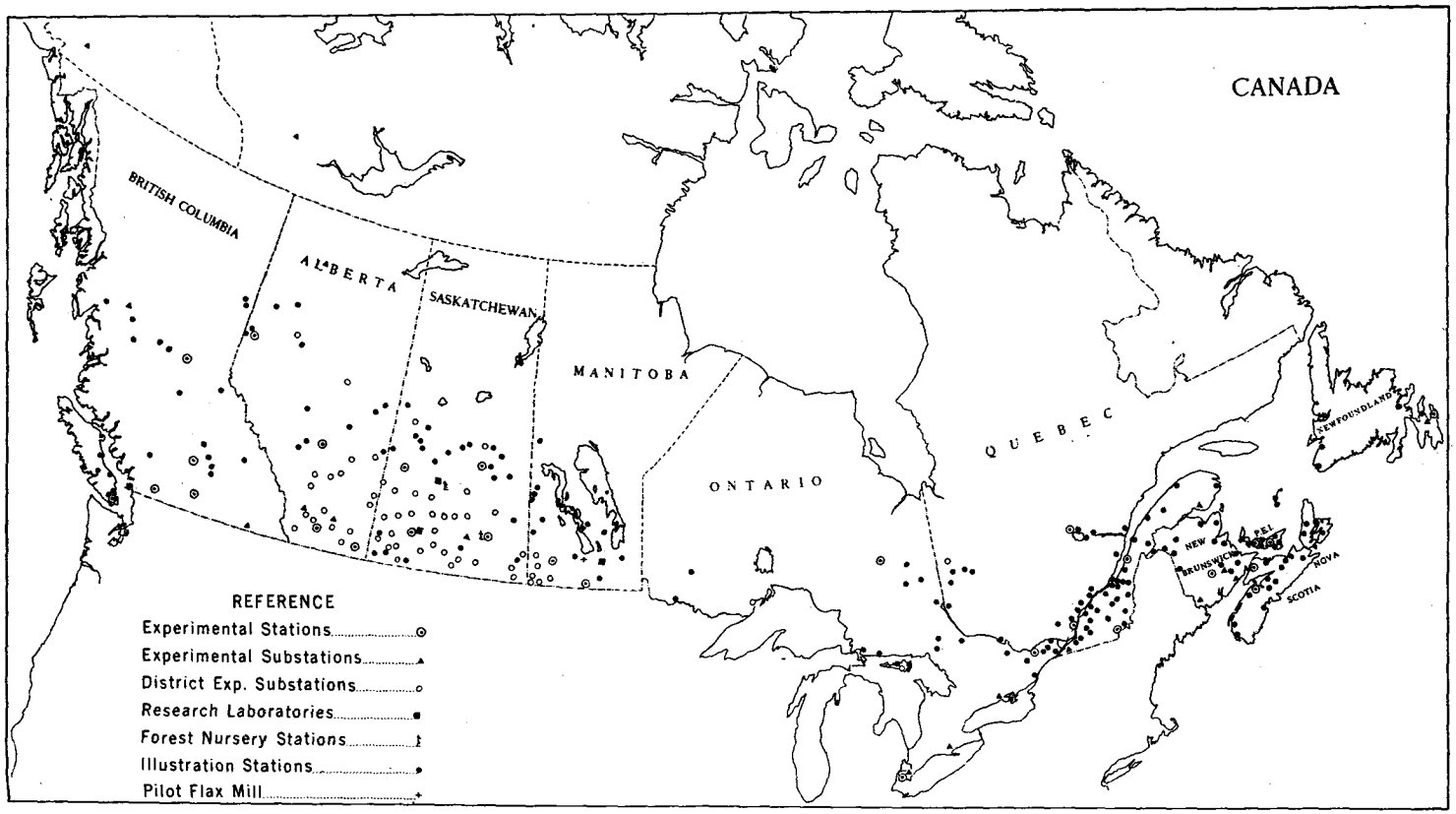
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District Exp. Substations
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RESEARCH STAFF

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Central Experimental Farm, Ottawa Ontario.

A. E. BARRETT, B.S.A., M.Sc. ..... *Chief.*
R. R. CAIRNS, B.S.A., M.Sc. ..... *Senior Agronomist*
J. G. PROVENCHER, B.A., B.Sc., Agr. (*Farm Crops*)
*I. F. FURNISS, B.S.A., M.S. ..... (*Farm Management*)
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Kapuskasing, Ont.
J. K. KNIGHTS, B.S.A.
Fort William, Ont.
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Ottawa, Ont.

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ILLUSTRATION STATIONS DIVISION

INTRODUCTION

The function of the Illustration Stations Division is to provide the framework for the conduct of experiments in outlying areas. The experimental program is designed to provide information on the nature and variability of farm problems in Canada and the measures that should be taken to provide an adequate solution to them. The 231 Illustration Stations and District Experiment Substations in Canada are linked with the more centrally located Experimental Farms and Stations and represent an expansion of the area of experimentation and research under conditions of commercial production. These station farms are so located that they represent areas and soil types not covered by the Experimental Farms and Stations with which they are associated. This enables an enlargement of the comprehensive work being conducted on the Experimental Farms in each province.

These 231 station farms are operated on privately owned properties on the basis of a co-operative agreement entered into between the owner and the Experimental Farms Service. Of this number 23 are located in British Columbia and supervised from the Experimental Farms at Saanichton, Agassiz, and Prince George; 31 in Alberta from Lethbridge, Lacombe, and Beaverlodge; 52 in Saskatchewan from Swift Current, Scott, Melfort, and Indian Head; 16 in Manitoba from Brandon; 23 in Ontario from Kapuskasing and the Central Experimental Farm, Ottawa; 47 in Quebec from Normandin, L'Assomption, Lennoxville, Ste.Anne-de-la-Pocatière, and Caplan; 13 in New Brunswick from Fredericton; 15 in Nova Scotia from Kentville and Nappan; 7 in Prince Edward Island from Charlottetown; and in 1951 four station farms were established in Newfoundland supervised from St. John's. The work carried out on each of these station farms has been summarized and the results appear as a section in the Progress Report prepared for distribution by each of the Experimental Farms concerned.

During the six-year period dealt with in this report the work of the Division was under the supervision of Mr. J. C. Moynan, now retired. During the same period one member of the staff, Mr. F. B. Kinsman, died. Staff separations as a result of promotions to other posts in the Federal Service or transfers to other work outside the Department include P-E. Leroux, W. A. Burgess, J. H. Wiley, F.-X. Gosselin, A. W. Wilton, A. R. Aitken, D. J. Macdonald, J. R. Barry, L. Bellefleur, and A. N. Longair.

During this period the following members of the staff were appointed: G. G. Smeltzer, J.-E. Comeau, R. Martineau, R. Bernier, D. Enns, L. J. Anderson, P. B. Hoyt, S. R. Church, B. C. Appleby, E. H. Gardner, and G. Provencher.

The Progress Report summarizes the results of work carried out during the period from 1948 to 1953, inclusive. It also represents a continuation and expansion of projects dealt with in the 1938-1947 Progress Report on Illustration Stations Division undertakings throughout Canada.

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Illustration Stations and District Experiment Substations Located by Provinces

In the development of Illustration Station and District Experiment Substation work the Experimental Farms Service has adopted a policy of undertaking the study of specific farm problems on privately owned farms rather than on government properties. By this plan it is possible for the different Experimental Farms across Canada to study farm production problems of a local character in their natural environment. When reviewing the work and some of the results that have been obtained over the past six years in this Progress Report, frequent reference will be made to certain localities in Eastern and Western Canada. Reference of this kind will be in connection with undertakings on one or more of the stations. The location of each station, with the name of the co-operating farmer who has made this working arrangement possible, is listed by provinces:—

Location by Province	*Co-operating Farm Owner*
British Columbia	
Alberni	S. J. Darby and Sons
Armstrong	W. B. McKechnie
Armstrong	Levi Johnston
Baldonnel	H. G. Hadland
Chase P.O.	R. C. Dunn
Cloverdale	T. Kuhn
Cobble Hill	F. R. Parr
Courtenay	James Casanave
Darfield	Bruno and Ulrich Schilling
Fort Fraser	W. F. Clarke
Grassy Plains	Blake and Archibald McGibbon
Houston	Peter Ruiter
Kersley	Gordon Beath and A. Foyle
Koksilah	B. Young
Ladner	Murray Davie
McBride	A. E. Long
Mount Cartier P.O.	R. Hold
Nanaimo	A. C. Galloway
North Pine	Albert Germain
Pemberton	J. C. Collins
Salmon Arm	L. E. Stewart
Terrace	Peter Van Stolk
Vanderhoof	J. Andros
Creston	Creston Reclamation Company
Alberta	
Chauvin	E. A. Pitman, Jr.
Chedderville	Howard Williams
Deadwood	John Nicklason
Evansburg	Rudolph Weist and Sons
Fort Kent	W. G. Levasseur
Goodfare	Clayton Third
High Prairie	L. R. Cowell
Hines Creek	Jacob Syrnyk
Hythe	A. Hill
Leslieville	G. N. Lynn
Ryley	George Lyons and Sons
St. Paul	J. Rodolphe La France
Acadia Valley	W. A. Heiden
Acme	Ralph Brown
Athabaska (Gray Wooded Soil)	Joe Eherer
Bindloss	John Barnes
Castor	F. M. Pals
Claresholm	D. L. Reynolds
Craigmyle	J. L. Branum
Dalroy	Free lease from CPR
Drumheller	L. O. and P. R. Andrew

Location by Province	*Co-operating Farm Owner*
Foremost	C. G. Wolfe
Lomond	E. M. Benson
McLennan (Gray Wooded Soil)	Narcisse Lamoureux
Metiskow	E. Masson
Nobleford	G. J. Withage
Pincher Creek	E. P. Cyr
Taber	Town of Taber
Whitla	Mrs. R. H. Babe and W. N. Babe
Saskatchewan	
Avonlea	Joseph Dombowsky
Archerwill	Selmar J. Slind
Carrot River	River Bend Coop. Farm Ass.
Dorintosh	J. Spreitzer
Glaslyn	S. Wood
Glenbush	John C. Grant
Hafford	Edward P. Hudek
Henribourg	Donat Bolduc
Marsden	George Jones
Paddockwood	Sidney Martin
Parkside	Godfrey Willoughby
Somme	D. Z. Chute
Star City P.O.	T. W. Jacklin and Sons
Turtleford	Evert Bloom
Wawota	W. H. Pryce
White Fox	P. Tornquist
Yorkton	James Harris
Alameda	Gordon F. and Stanley Young
Arcola	Clarence Marsh
Aylesbury	Charles McMillan
Bracken	James Honey
Carmichael	A. C. Butler
Conquest	Hugh Kennedy
Eastend	Graham Higgins
Fleming	Gordon Osborne
Fox Valley	D. Mutschler
Gilroy	Frank Cocks
Gravelbourg	Walter, Maurice and J.-B. Pinsonneault
Guernsey	C. H. Snider
Kelliher	R. L. Church
Kincaid	Wm. C. Phillips
Kindersley	Robert Simpson
Kyle	G. A. Noble
Limerick	J. W. and J. T. Smith
Lisieux	O. Prefontaine
Loon Lake (Gray Wooded Soil)	R. Kisling
Loverna	Allan Brumwell
Maple Creek	D. A. Colquhoun
Radville	G. L. and C. L. Levee
Rosetown	Peter Macey
Shackleton	C. D. Underwood
Shaunavon	H. Hockett
Snowden (Gray Wooded Soil)	W. D. Brown
Strasbourg	Ambrose Coles J. G. Hooper
Tugaske	Lindsay Wilson
Viceroy	L. L. Gyman
Valjean	Fred Lindquist
Eastend	Wilbert H. Lewis
Estevan	James Lamb
Val-Marie	Jack Spiess
Consul	J. Reesor
Maple Creek	R. Sandau

Location by Province		*Co-operating Farm Owner*
Manitoba		
Arborg		Victor Shebeski
Ashern		Frank Self
Beausejour		Ed. Modrzejewski
Durban		R. C. and W. A. Harvey
Grandview		Sherman Clark
Katrime		W. A. Heselwood
Kenville		H. A. Loat
Lenswood		Arthur Utting
Morris		Edward P. Berard
Silverton		Joseph J. Dunn
The Pas		John Jaegar
Boissevain		C. C. Musgrove and Son
Goodlands		Clinton and Stewart Bell
Hargrave		J. R. and H. C. Odell
Lyleton		J. G. Parsons G. H. Edgar
Pipestone		Harold Forder
	County	
Ontario		
Appleton	Lanark	Duncan W. Stewart
Bloomfield	Prince Edward	Holmes Matthie
Caledonia Springs	Prescott	Henri-J. Gauthier
Casselman	Russell	Hector Laflèche
Dayton	Algoma	Wm. J. Boville
Douglas	Renfrew	Duncan McLaren
Earlton	Témiskaming	Albert Rivard
Fort Frances	Rainy River	Wm. and Amos Lowe
Fournier	Prescott	L. McCulloch
Genier	Cochrane	Albert Tousignant
Gore Bay	Manitoulin	Cameron Clark
Kenora	Kenora	George Kovall
Lyn	Leeds	H. Harris McNish and Son
Matheson	Cochrane	Gerald Scratch
Manitowaning	Manitoulin	Lloyd J. Kerr
Noelville	Sudbury	Raoul Carrière
Mattagami Heights	Cochrane	J.-B. Lévesque
Verner	Nipissing	Ernest Beaudry
Williamstown	Glengarry	D. A. MacRae
Fort William	Thunder Bay	Campbell Hanna
Mindemoya	Manitoulin	Walter and Peter Williamson
Quebec		
Amos	Abitibi	Léonel Cossette
Amqui	Matapédia	Eugène Belzile
Batiscan	Champlain	Antonio Brunelle
Cap-Chat	Gaspé-Nord	Philippe Labrie
Cap-d'Espoir	Gaspé-Sud	Pierre Dégarie
Chapeau	Pontiac	Tom Kennedy
Cloutier	Témiscamingue	Ovide Gauvin
East Broughton	Beauce	Ernest Doyon
Granby	Shefford	Isidore Martin
Grandes-Bergeronnes	Saguenay	Albert Simard
Grindstone	Iles-de-la-Madeleine	Edvard Bouffard
Honfleur	Bellechasse	A. Laliberté
L'Acadie	St-Jean	Charles Deland
Lachevrotière	Portneuf	Rosaire Mayrand
Lamorandière	Abitibi	Napoléon Letourneau
La Patrie	Compton	Louis Langlois
Launay	Abitibi	Adolphe Lord
Laverlochère	Témiscamingue	Albéric Trudel
L'Islet-Station	L'Islet	J.-C. Lemieux
Luceville	Rimouski	Philippe Bouchard

Location by Province		*Co-operating Farm Owner*
Maskinongé	Maskinongé	Antonio Caron
Mont Brun	Abitibi	Georges Mercier
Mont-Rolland	Terrebonne	Paul Latour
Notre-Dame-du-Lac	Temiscouata	Georges Plourde
Notre-Dame-du-Bon-Conseil	Drummond	Lucien Lambert
Péribonca	Roberval	Joseph Savard
Pintendre	Lévis	Alphonse Couture
Portage-du-Cap	Iles-de-la-Madeleine	Aldéric Lapierre
Rivière-du-Loup	Rivière-du-Loup	Alcide Nadeau
St-Ambroise	Chicoutimi	Mrs. E. Pedneault
St-Flavien	Lotbinière	Albert Laroche
St-Constant	Laprairie	Roch Boulé
St-Damase	St-Hyacinthe	Armand Beauregard
St-Etienne-des-Grès	St-Maurice	Roger Bournival
St-Gédéon	Lac-St-Jean	Joseph-A. Simard
St-Grégoire	Nicolet	Mrs. F.-I. Bouvet
St-Jacques	Montcalm	Paul Marsolais
St-Nérée	Bellechasse	Lazare Asselin
St-Paul-de-Montminy	Montmagny	H. Gaudreau
St-Pierre-d'Orléans	Montmorency	Adélard Rousseau
St-Prosper	Dorchester	Eugène Larochelle
St-Sébastien	Frontenac	Edouard Lachance
St-Urbain	Charlevoix	Adrien Harvey
St-Vallier	Bellechasse	Albert Aubé
Thetford Mines	Mégantic	Emile Couture
Wotton	Wolfe	Napoléon Corbeil
Macamic	Abitibi	Rémi Auger

New Brunswick

Baker Brook	Madawaska	Claude Levasseur
Cumberland Pt.	Queens	Mrs. W. C. McQuinn
East Centreville	Carleton	Ernest Emery
Lower Derby	Northumberland	W. R. Taylor
Mount Carmel	Kent	Cloris Melanson
Salisbury	Westmorland	Truman Lewis
Salmonhurst	Victoria	Jens Larsen
Siegas	Madawaska	Roméo Ruest
Stanley R.R. No. 7	York	Howard Sandwith
St. Charles	Kent	Antoine-J. Daigle
St-Isidore	Gloucester	Peter Robichaud
St. John R.R. Stn.	St. John	A. B. Shillington
St-Quentin	Restigouche	Martial Dubé

Nova Scotia

Aylesford	**Kings**	**C. S. Bezanson** **M. P. Nichols** **C. E. Smith**
Big Pond	**Colchester**	**Alex MacIntyre**
Glenora Falls	**Cape Breton**	**Joseph Beaton**
Goshen	**Inverness**	**Roy Sinclair**
Knoydart	**Guysborough**	**D. M. McDonald**
Lunenburg	**Lunenburg**	**W. I. Falkenham**
Mavillette	**Digby**	**J. R. Deveau**
North East Margaree	**Inverness**	**T. E. Ross**
Newport	**Hants**	**Ralph H. Zwicker**
Noel Shore	**Hants**	**J. L. Main**
West River Station	**Pictou**	**Fred Setchell**

Location by Province		*Co-operating Farm Owner*
New Glasgow	Pictou	E. V. Paine
Stewiacke	Colchester	G. E. Campbell
Tatamagouche	Colchester	Douglas Tattrie
Prince Edward Island		
Alliston	Kings	T. A. Hicken
Armadale	Kings	Hugh J. MacDonald
Breadalbane	Queens	John W. MacKenzie
Iona	Queens	J. E. Daly
New London	Queens	Wm. Johnstone
O'Leary	Prince	Robert Woodside
Urbinville	Prince	Zénon Gallant
Newfoundland		
Carbonear		George E. Soper
Doyles		George Cormier
Heatherton		Neil McDonald
Lethbridge		James Harris

FARM PLANNING AND ORGANIZATION

The standard procedure followed in the organization of an Illustration Station is the development of a land-use pattern. This includes the establishment of a systematic cropping plan and rotations adapted to the soil and climatic conditions of the locality, as well as the type of production desired or considered advisable. During the years since the inception of the work of the Illustration Stations Division in 1915, the variety of conditions encountered has resulted in the undertaking of studies to determine the adaptability of some twenty-two rotations with varying crop sequences in Eastern Canada and British Columbia. In the three Prairie Provinces thirty types of grain-growing and mixed-farming rotations are under study to determine the crop sequences best adapted to the conditions of the districts where the stations are located. The rotations studied in Eastern Canada and British Columbia vary from one of three years duration, especially adapted to the growing of cash crops, to a ten-year rotation best suited to livestock areas where forage crops persist over long periods. The rotations under study in the Prairie Provinces vary from a two-year summerfallow and wheat sequence in the specialized grain-growing districts, to four, five, and even longer crop-year cycles in the more northerly mixed-farming areas.

On the southwestern Manitoba Stations the four-year rotation of fallow, wheat, hay and break, coarse grain is rated one of the best from the standpoint of land use and returns. The three-year fallow, wheat, wheat rotation is one of the poorest from the standpoint of controlling weeds, especially wild oats. The short-term grain rotations are most widely adopted in the grain-growing regions of Manitoba, but in the mixed-farming areas grass and legume crops are required to provide feed for livestock. The eight-year rotation is being widely tested and in the more humid regions of the province it has been under study for 15 years. Average yields of wheat per acre on summerfallow under this long-term rotation have been equally high and in a number of cases higher than those obtained under the short-term rotations.

An example of the results obtained from long-term rotations, which incorporate forage crops, as compared with shorter rotations, with no hay crops, on the overall productivity of the farm, is demonstrated by the results on the Illustration Station at White Fox, Sask. Three different crop rotations have been under study at this station in northeastern Saskatchewan for the past

sixteen years. The rotations that have been compared are: a three-year rotation of fallow, wheat, oats, a four-year rotation of wheat, oats, hay, hay, and a six-year rotation of fallow, wheat, hay, hay, wheat, oats. Table 1 gives the sixteen-year averages of yields, cost of production, total returns and net revenues *per acre* from these rotations.

TABLE 1.—Results of Rotation Studies at White Fox, Sask.

(Sixteen-year Averages)

Rotation and crop	Yield per acre	Cost of production per acre	Total returns per acre	Net returns per cultivated acre from rotation		
				Each crop	All crops	Cash crops
	(bu. or tons)	$	$	$	$	$
Three-year Rotation						
Fallow		5.45				
Wheat	23·2	13.57	34.80	21.23		
Oats	31·9	11.48	20.74	9.26		
Total					30.49	30.49
Average for Rotation					10.16	10.16
Four-year Rotation						
Wheat	27·5	10.80	41.25	30.45		
Oats	44·1	10.22	28.67	18.45		
Hay	1·24	7.62	12.40	4.78		
Hay	1·32	9.80	13.20	3.40		
Total					57.08	48.90
Average for Rotation					14.27	12.22
Six-year Rotation						
Fallow		5.31				
Wheat	34·6	14.52	51.90	37.38		
Hay	1·48	9.72	14.80	5.08		
Hay	1·48	9.79	14.80	5.01		
Wheat	26·3	10.69	39.45	28.77		
Oats	45·4	10·62	29.51	18.89		
Total					95.13	85.04
Average for Rotation					15.86	14.17

In computing the total returns per acre from the three rotations, the same average values were used for each crop. Wheat was valued at $1.50 per bushel, oats $0·65 per bushel, and hay $10.00 per ton. In calculating the value of the cash crops alone, no amount was deducted from the expenses for the cost of harvesting the hay.

It will be noted from the foregoing table that the average annual net returns per acre for all crops produced on the area under the six-year mixed-farming rotation was $15.86 as compared with $14.27 and $10.16 for similar fields which were farmed in the four- and three-year cropping sequences, respectively. When the returns from the cash crops only are considered, that is, without including any revenue from the hay crops, the average annual net revenue per acre for fields in the six-, four- and three-year rotations were $14.17, $12.22 and $10.16 per acre, respectively.

It will be noted that the fields in the four-year rotations have not been given a complete summerfallowing in sixteen years. The fields in the six-year rotation are given a complete summerfallowing once in six years and summerfallowing is done once every three years on fields in the three-year rotation.

Fig. 1.

KATRIME, MANITOBA
ILLUSTRATION STATION

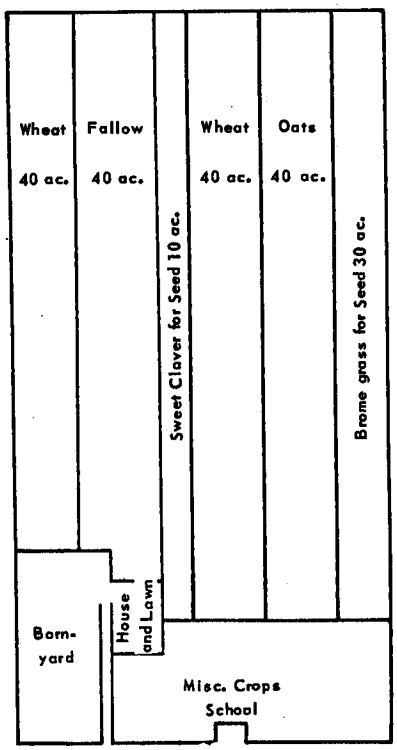
Original Field Layout

Four-Year Rotation
- Fallow
- Wheat
- Wheat
- Oats

and some Forage Crop Production

New Field Layout

Eight-Year Rotation
- Fallow
- Grain
- Grain to Hay
- Hay
- Pasture
- Break
- Grain
- Grain



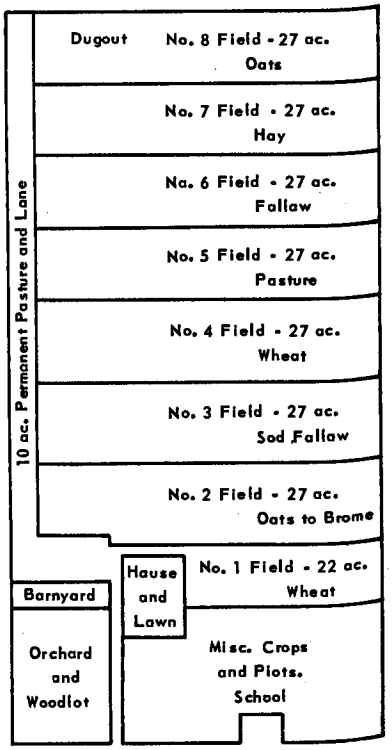
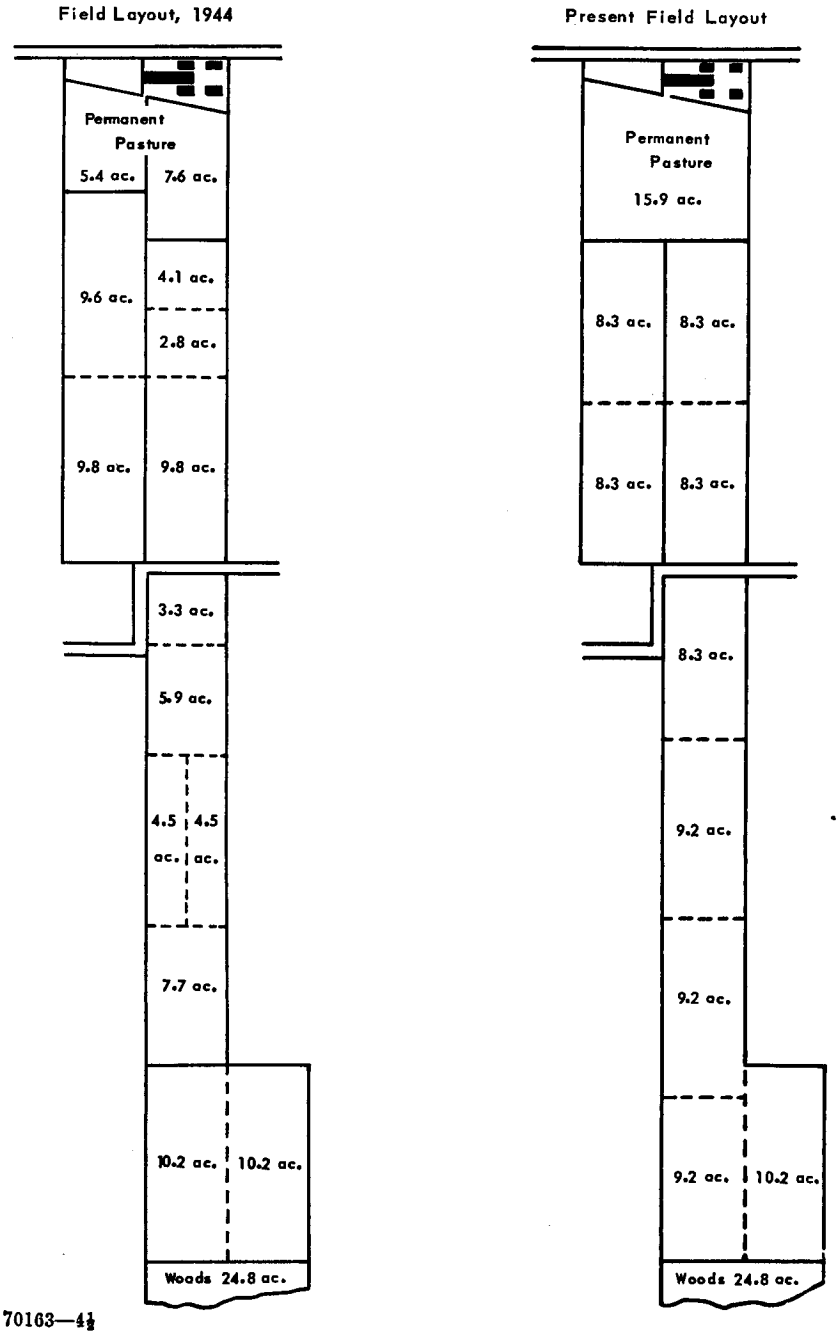


Fig. 2.

MASKINONGE, QUE.
ILLUSTRATION STATION



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The cost of summerfallowing is quite high in this area and thus the *frequency* of it has a direct bearing on the cost of producing succeeding crops. This is one important factor that accounts for the success of the long-term rotation. However, soil conserving value derived from growing hay crops in this area of Saskatchewan has definite financial benefit. This is well demonstrated by the increased net revenue resulting from initiation of rotation sequences that incorporate forage crops in the rotation.

In the mixed-farming districts of Eastern Canada and British Columbia the tillable area per farm is not extensive. On the Illustration Stations in this area, about 46 per cent of the total farm area is tillable. This necessitates careful planning of each unit in order that a high level of balanced production may be achieved. The rotation plan must be designed to fit in with the type of livestock production, whether dairy, beef cattle, poultry or hogs; the soil type; topography and drainage. Where cash crops are grown it is often necessary to have a special rotation for them, thus leading to the establishment of two and sometimes three rotations on one farm.

In the Lennoxville district of central Quebec the four-year rotation of hoed crops or cereals, cereals, clover hay, mixed hay is the most popular. This rotation is followed on 12 of the 14 stations in the district. On several of the stations in this district only one rotation system is used; on six stations two four-year systems are followed; and on one station there are three four-year rotations. Reasons for establishing more than one rotation system on each farm in this district are differences in soil type and non-contiguous farm units. The five-year rotation of hoed crops and cereals, cereals, clover hay, mixed hay, timothy and alfalfa hay or pasture is followed on two stations.

SOIL FERTILITY INVESTIGATIONS ON FIELD CROPS

Soil fertility studies are under way on all Illustration Stations and District Experiment Substations. Seventy-three per cent of the Stations have now been subjected to a detailed soil survey and every effort is being made to relate the results of fertility studies to each soil type, crop requirement, and past soil treatment. In those areas where the soil was developed under forest vegetation, particular attention is paid to the long-term aspects of fertility On the naturally more fertile soils, which developed under grassland vegetation, the immediate effect of the fertilizer is of more concern than the long-term effects. Increasing emphasis is being given to the time and methods of applying fertilizer because of the high fixing power of most soils for phosphorus and the ready leachability of nitrogen, potash, and sulphur. Because of the extreme immobility of phosphorus and calcium in the soils, studies are being conducted, chiefly in the Maritime Provinces, to determine alternatives to the surface application of fertilizers in the rejuvenation of long-term pastures.

Crop Response to Applied Fertilizers on Gray Wooded Soils

Detailed soil fertility studies on Gray Wooded soils are being conducted on four Substations located at McLennan and Athabasca in Alberta, and Loon Lake and Snowden in Saskatchewan, and on fourteen associated Illustration Stations. The soil at McLennan is representative of the Nampa series which covers upwards of 30,000 acres. The Loon Lake Substation is representative of the Loon River Association of which 400,000 acres have been mapped. Snowden is representative of the Garrick and Smeaton Associations of which 55,000 acres of Garrick and 40,000 acres of Smeaton soil have been mapped. Various other members of the Gray Wooded soils are also under study on Illustration Stations. While no specific mapping of the Athabasca area has

yet been done, the Substation located here is representative of a wide area of soils which fall into the broad classification of Gray Wooded.

The individual characteristics of these soils are clearly shown by variable response of crops to specific fertilizer treatments. The gray soils at Chedderville, Alta., respond to sulphur. Results of a fertilizer formulae study conducted within a five-year grain–hay rotation during the past four years reveal that nitrogen and phosphorus play an important role in wheat production at McLennan with high levels of nitrogen being more important than high levels of phosphorus. Potash has given no appreciable increase in the yield of wheat at McLennan. At Loon Lake, sulphur is markedly deficient and applications of gypsum have given slight wheat yield increase and increased the yield of legume hay from less than one-third to over three tons per acre. On Garrick soils at Snowden, nitrogen, phosphorus, and potash all have had a positive effect on the yield of wheat but there has been, as yet, no apparent effect of sulphur on the yield of either wheat or hay. The soil at Athabasca is most variable and no specific results have been obtained to date. Studies are continuing with a view to being able to supply specific information for the improvement of crop production on these soils as they are identified and brought under cultivation. The average yields of wheat produced under various levels of applied nitrogen, phosphorus, potash, and gypsum are presented in Table 2.

TABLE 2.—The Effect of Applications of Nitrogen*, Phosphorus*, Potash,* and Gypsum on the Yield of Wheat on Gray Wooded Soils.

Station	Years tested	Treatment and rate of application in pounds per acre							
		N		P_2O_5		K_2O		gypsum	Check
		6	12	15	30	0	15	100	
		bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu
McLennan, Alta.	3	16·2	18·8	16·5	18·4	17·4	17·6	14·0	14·4
Athabasca, Alta.	2	30·2	30·4	29·1	31·4	31·2	29·3	27·7	32·1
Loon Lake, Sask.	2	19·1	18·7	18·7	19·2	18·4	19·5	20·1	17·8
Snowden, Sask.	4	44·6	44·6	44·0	45·2	43·5	45·7	38·6	37·7

*The different levels of each element are tested in combination with the remaining two.

The Response of Wheat to Fertilizer Treatments

The response of wheat on fallow to fertilizer treatment has been widely studied in the Black, Dark Brown and Brown soil zones of the Prairie Provinces. It has been found that response to fertilizer is not constant in every wheat growing area nor does it occur in every year. Marked yield increases from fertilizer are common in the Black soil zone, can be expected to occur in the Dark Brown soil zone, and have been sporadic in the Brown soil zone. In all zones results have been most pronounced in years of adequate moisture. Applications of phosphorus in the form of 11-48 or 16-20 hasten crop maturity, thus often reducing frost damage to the crop. The application of nitrogen, which is present in the same two formulae, is of marked benefit in years of cold, damp springs. Under these conditions, bacterial action is at a minimum and the organic nitrogen present in the soil is not rapidly released for use by the seedling plants. Nitrogen is also of special importance in crops seeded into heavy stubble where the fungi and other organisms decomposing the trash, compete with the growing crop for the available nitrogen. The crops suffer under these conditions, unless an additional supply of this element is provided.

FIG. 3. Project IS-02.02—Plant Food Deficiency Studies with Clover on Gray Wooded Soils, Chedderville, Alta.—Left: Check—no treatment—Right: Ammonium sulphate applied at 80 pounds per acre.

The lack of nitrogen is usually evidenced by a yellowing of the crop in the early stages of growth. No specific advantage has been found from the use of potash on cereal crops on these soils.

The possibility of a relationship between soil moisture reserve and wheat response to fertilizer is under study. However, sufficient data have not yet been procured to establish such a relationship. The fertilization of stubble crops is also under study and information is available from local experimental farms.

Results of a uniform experiment conducted throughout varying periods of years on Illustration Stations and District Experiment Substation farms in the Prairie Provinces indicate the increase in wheat yield that can be expected from fertilizer applications on the major soil types in the Black and Dark Brown soil zones. In these trials the fertilizers were drilled in with the seed. The data from this study are summarized in Table 3.

TABLE 3.—Effect of Fertilizers on Yields of Fallow Wheat in the Black and Dark Brown Soil Zones 1949–1953

Treatment per acre	Black soil 24 tests	Dark Brown soil 21 tests
	bu./ac	bu./ac.
Check (no treatment)	32·3	31·1
11–48 at 20 lb.	35·8	33·6
11–48 at 40 lb.	37·6	35·1
11–48 at 60 lb.	39·5	34·1
16–20 at 48 lb.	35·9	33·7
16–20 at 96 lb.	37·1	35·4
Triple superphosphate at 25 lb.	35·3	32·4
Triple superphosphate at 50 lb.	35·7	33·3
11–48 at 40 lb. + 20 lb. mur. of potash	37·2	34·5
16–20 at 96 lb. + 20 lb. mur of potash	39·4	34·5
Triple super. at 50 lb. + 20 lb. mur. of potash	37·1	33·5

SOIL TYPES REPRESENTED IN ABOVE GROUP AVERAGES:

Station	*Soil type*	*Number of years of tests*
Black Soils		
Archerwill, Sask.	Whitewood Light Loam	2
Birch Hills, Sask.	Melfort Silty Clay Loam	1
Carragana, Sask.	Tisdale Heavy Clay	1
Fleming, Sask.	Naicam and Ryerson Loam and Clay	4
Henribourg, Sask.	Shellbrook Fine Sandy Loam	2
Wawota, Sask.	Ryerson Loam	3
Yorkton, Sask.	Canora and Yorkton Silty Clay Loam	5
Marsden, Sask.	Blaine Lake Loam	1
Parkside, Sask.	Shellbrook Light Loam	2
Hargrave, Man.	Oxbow Clay Loam	2
Dark brown soils		
Boissevain, Man.	Waskada Clay Loam	2
Goodlands, Man.	Waskada Clay Loam	2
Lyleton, Man.	Souris Fine Sandy Loam	2
Pipestone, Man.	Bede Coarse Sandy Loam	2
Alameda, Sask.	Estevan Clay Loam	3
Arcola, Sask.	Alluvial and Asquith Light Loam	2
Conquest, Sask.	Asquith and Elstow Clay Loam	2
Guernsey, Sask.	Meota Fine Sandy Loam	1
Rosetown, Sask.	Elstow Silty Clay	2
Strasbourg, Sask.	Oxbow Loam	3

It will be noted that there has been an overall average yield increase from the use of up to 60 pounds of 11-48 per acre on the Black soils and up to 40 pounds of 11-48 on the Dark Brown soils. Likewise, applications of 16-20 provided an overall increase but less economically, particularly on the Dark Brown soils. Phosphorus alone, in the form of triple superphosphate, also produced yield increases, but less markedly than when combined with nitrogen as in 11-48 and 16-20. The addition of potash did not prove to be generally beneficial. The yield increases from fertilization were generally more

FIG. 4. Project IS-02.10—The Effect of Fertilizer on Wheat on Dark Brown Soils, Craigmyle, Alta. The taller, higher-yielding plot on the left was treated with 11-48-0 at 25 pounds per acre. The plot on the right of the stake is the unfertilized check.

substantial on the Black than on the Dark Brown soils. They were also more consistent from year to year and station to station on the Black soils. Crop response proved more dependent on seasonal moisture conditions on the Dark Brown soils stations. The best treatment varied somewhat from station to station in both soil zones.

FIG. 5.—Project IS-02.10—Fertilizer Test with Wheat on Black Soil, July 8, 1952, Bonnyville—Left—Check—no treatment—Right—A.P. 11-48 at 50 pounds per acre.

Few worthwhile responses of wheat to fertilizer treatment have been found on Brown soils. Results from an experiment conducted through a five-year period on five Stations in the Lethbridge district of supervision indicate no marked response to fertilizer treatment. The cumulative average yields for each treatment at all locations through the five-year period indicate that increases in yield did not exceed 1·2 bushels per acre. The data procured from this study are set forth in Table 4.

TABLE 4.—Effect of Fertilizers on Fallow Wheat in the Brown Soil Zone (Alberta)

Five-year average, 1948–52

Treatment per acre	Acadia Valley	Bindloss	Foremost	Lomond	Whitla	Group average All stations
	bu.	bu.	bu.	bu.	bu.	bu.
Check	21·2	18·8	24·3	32·7	15·8	22·6
11–48 at 50 lb.	23·7	19·3	24·4	35·1	16·6	23·8
11–48 at 25 lb.	23·4	18·8	24·1	33·9	16·4	23·3
11–48 at 25 lb. + K_2O at 12 lb.	23·8	19·8	23·0	34·6	16·7	23·6
Triple superphosphate at 56 lb.	23·2	21·0	23·6	33·8	16·0	23·5
Ammonium sulphate at 28.5 lb.	20·3	19·1	23·5	33·2	16·8	22·6

SOIL TYPES REPRESENTED ON STATIONS

Acadia Valley	Lacustrine Clay and Clay Loam
Bindloss	Aeolian Silty Loam
Foremost	Lacustrine Silty Loam
Lomond	Glacial Clay Loam
Whitla	Glacial Loam and Light Silty Loam

Fertilization of Potatoes in Eastern Canada

In terms of fertilizer usage, the potato crop is one of the greatest consumers of fertilizer materials on a per crop acre basis. In the main, the lighter textured soils which are most suitable for potato production are low in natural fertility and usually are acid which further accentuates the problem of maintenance of fertility. Where large amounts of chemical fertilizers are involved, it is doubly important that specific information be procured as to the levels of nitrogen, phosphorus, and potassium application that will give the most advantageous yield increases. In order to provide information on this problem fertilizer formulae studies have been conducted on Illustration Station farms in the commercial potato growing areas of Canada.

When manure is available, these studies are conducted in conjunction with it; when the supply is limited, the studies are conducted with and without it; and when none is to be had the tests are conducted without manure. In all cases, fertilizer studies on this crop are conducted within a rotation suitable for potato production. In addition to yield, the effect of fertilizers on the quality of the tubers and the incidence of disease is also measured.

In a six-year study at New London, P.E.I., varying levels of nitrogen, phosphorus, and potash have been tested within a four-year crop rotation. Four initial applications of fertilizers on potatoes have been made and two repeat applications. The fertilizers are studied in conjunction with manure and in the absence of manure. The levels of nitrogen studied were 45, 90, and 135 pounds per acre; of phosphate 120, 180, and 240 pounds of P_2O_5 per acre; and of potash 75, 150, and 225 pounds of K_2O per acre. Manure substantially increased yields as did increased levels of nitrogen and potash over the four-year period of the initial applications. Increased levels of phosphorus had little effect on yield. Similar results were obtained in the presence and absence of manure. It should be noted that in 1951, a severe blight year, each treatment that increased the four-year average yield, decreased yields in that year. The more lush growth of that year had a higher incidence of blight damage. It might also be mentioned, that the two elements nitrogen and potash which increased yields, also significantly, but slightly, reduced the percentage of dry matter. Phosphorus, like manure, has no appreciable effect on dry matter. In the repeat applications made in 1952 and 1953, somewhat different results were obtained in that increased levels of phosphorus caused marked increases in yield. Tables 5 and 6 show a summary of these yield data for the initial and repeat applications respectively.

A similar experiment has been conducted since 1948 at Luceville, Que. In this study the fertilizers were supplied at a slightly lower level, but in the same proportions. The results of this study are presented in Table 7, showing the effect of initial and repeat applications. It will be noted in the results of the initial applications that the response to increasing levels of the various nutrients was not so clear-cut as that obtained at New London. The response to nitrogen was evident regardless of manurial treatments. Phosphorus gave a yield increase at intermediate and at high levels in the initial applications and at the intermediate level, only, in the repeat applications. There has been no response to increased levels of potash in the initial applications, but slight responses were obtained in the repeat application.

TABLE 5.—Effect of the Initial Application of Varying Levels* of Nitrogen, Phosphate, and Potash with and without Manure on the Yield of Potatoes, New London, P.E.I.

Treatment per acre	Average yield of potatoes 1948–1951	
	Manure 10 tons	No manure
	bu./ac.	bu./ac.
Nitrogen—45 lb	370·3	324·0
Nitrogen—90 lb	379·5	343·4
Nitrogen—135 lb	386·2	352·0
Phosphate—(P_2O_5) 120 lb	378·2	337·0
Phosphate—(P_2O_5) 180 lb	378·9	340·4
Phosphate—(P_2O_5) 240 lb	378·8	342·1
Potash—(K_2O) 75 lb	369·6	321·9
Potash—(K_2O) 150 lb	382·0	339·9
Potash—(K_2O) 225 lb	384·3	357·6

*The different levels of each element are tested in combination with the remaining two.

TABLE 6.—Effect of the Repeat Application of Varying Levels* of Nitrogen, Phoshate, and Potash with and without Manure on the Yield of Potatoes, New London, P.E.I.

Treatment per acre	Average yield of potatoes 1952–1953	
	Manure 10 tons	No manure
	bu./ac.	bu./ac.
Nitrogen—45 lb	429·1	327·0
Nitrogen—90 lb	444·8	353·0
Nitrogen—135 lb	457·4	359·6
Phosphate—(P_2O_5) 120 lb	433·2	325·1
Phosphate—(P_2O_5) 180 lb	440·5	348·4
Phosphate—(P_2O_5) 240 lb	457·7	366·0
Potash—(K_2O) 75 lb	421·8	315·6
Potash—(K_2O) 150 lb	454·6	352·4
Potash—(K_2O) 225 lb	455·0	371·6

*The different levels of each element are tested in combination with the remaining two.

TABLE 7.—Effect of the Initial Application of Varying Levels* of Nitrogen, Phosphate, and Potash with Manure on the Yield of Potatoes, Luceville, Que.

Treatment per acre	Average yield of Potatoes per acre	
	Initial application 1948–1951	Repeat application 1952–1953
	Manure	Manure
	bu.	bu.
Nitrogen—30 lb	283·8	241·3
Nitrogen—60 lb	293·6	262·8
Nitrogen—90 lb	296·8	248·8
Phosphate—(P_2O_5) 80 lb	273·9	247·2
Phosphate—(P_2O_5) 120 lb	297·7	257·9
Phosphate—(P_2O_5) 160 lb	302·4	241·2
Potash—(K_2O) 50 lb	290·9	241·0
Potash—(K_2O) 100 lb	290·9	242·4
Potash—(K_2O) 150 lb	292·3	262·9

*The different levels of each element are tested in combination with the remaining two.

In a fertilizer formulae study at St.-Quentin, N.B., conducted in 1948 and 1950, there was no significant difference between the various formulae studied when applied at the rate of 1,500 lb. per acre as a supplement to manure. In this experiment the levels studied were 3, 6, and 9 per cent nitrogen; 8, 12, and 16 per cent P_2O_5 (phosphate); and 5, 10, and 15 per cent K_2O (potash) in all possible combinations. In a similar study conducted for six years at East Centerville, N.B., the intermediate levels of N, P_2O_5 and K_2O, as represented by 4-8-5 and 4-8-10, gave significant yield increases over other formulae combinations when applied at 2,000 pounds per acre as a supplement to manure.

In similar three-year studies conducted at Fort William and Kenora, Ont., altogether different responses were obtained. At Fort William, increased levels of nitrogen and potash did not benefit the crop, but at Kenora there was a marked yield increase from raising the level of both of these nutrients. Increased phosphorus levels gave large yield responses at both locations, as also did manure. At Fort William, the yield with manure and fertilizers was 364·4 bushels per acre compared with 329·3 bushels per acre with fertilizers alone. At Kenora the yield was 370·6 bushels per acre with fertilizers alone and 454·3 bushels per acre with manure and fertilizers. On no two of the six farms discussed has the same formula given the best results because these studies were conducted on widely separated farms and on soils developed under very different climatic conditions. The variability of response in each production area is indicative of the value of tests conducted on Illustration Stations on the various soil types as they occur.

The Fertilization of Tobacco

The effect of barnyard manure and chemical fertilizers on the yield and quality of cigar tobacco has been tested on the St.-Jacques, Que., Illustration Station during the past nine years. The results of this study are presented in Table 8.

TABLE 8.—Effect of Manure and Chemical Fertilizer Treatments on the Yield and Quality of Tobacco, St. Jacques, Que. 1945-1953 Inclusive

Treatment per acre	Yield per acre	Quality* index	Gross return per acre
	lb.	cts.	$
No Manure—1,000 lb. 5-8-10	1960	20·7	406
No Manure—750 lb. 5-8-10	1912	20·9	399
Manure 5 tons—1,000 lb. 5-8-10	1957	20·9	409
Manure 5 tons—750 lb. 5-8-10	1942	20·8	403
Manure 10 tons—1,000 lb. 5-8-10	1918	21·0	402
Manure 10 tons—750 lb. 5-8-10	1965	21·7	426

*Quality index is price per pound.

It will be noted from these data that there has been a slight benefit from the heavy rates of applying chemical fertilizer except where the heavy rate of manure was used. There has also been some benefit from the higher rates of applying manure, except where the heavier rate of chemical was used. The best treatment, in this study, has been the application of 10 tons of manure with 750 pounds of 5-8-10 per acre.

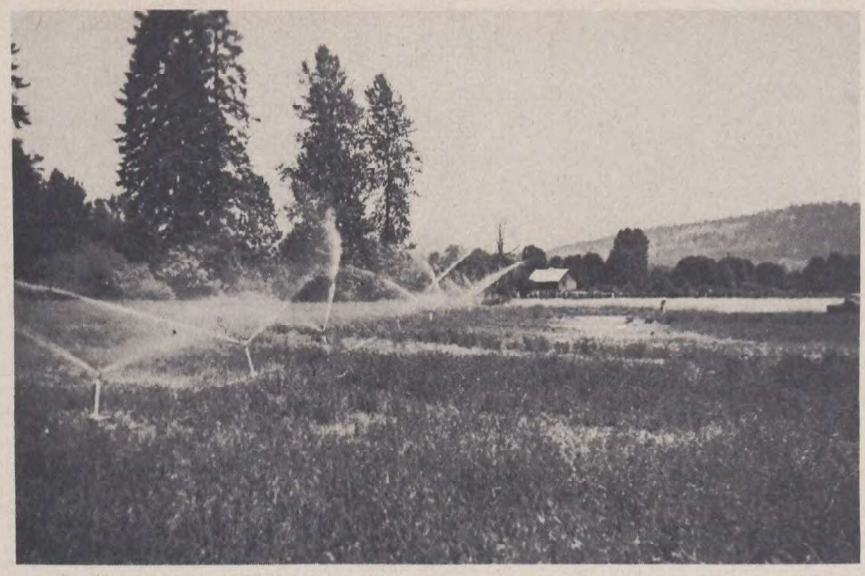


FIG. 6. Sprinkler Irrigation on Vancouver Island.

The Fertilization of Forage Crops under Irrigation

Irrigation studies have been conducted for only one year on the Illustration Stations on Vancouver Island. The application of 64 pounds of nitrogen at Nanaimo, B.C., increased the yield of hay from 1·56 to 2·73 tons of dry matter per acre, the addition of 80 pounds P_2O_5 (phosphate) gave no further yield increase, but the addition of 40 pounds K_2O (potash) increased the yield to 3·02 tons per acre. At Duncan, B.C., an application of 96 pounds of nitrogen, 120 pounds P_2O_5 and 60 pounds K_2O in the spring increased the yield of pasture from 2·30 to 3·29 tons of dry matter per acre. No benefit resulted from splitting the application and applying half in midsummer. While these results have been derived from only one year's work they do indicate the increased yield potential from fertilizer use where moisture supplies are adequate.

The Fertilization of Fiber Flax

The effect of various fertilizers on the production of fiber flax has been studied on Illustration Station farms at St.-Constant, Maskinongé and L'Acadie in Quebec. The soil at St.-Constant is Rideau clay; at Maskinongé Godfroy recent alluvial; and at l'Acadie, St.-Brigide gravelly loam. The results of these studies are presented in Table 9.

TABLE 9.—The Effect of Various Fertilizers on the Yield of Flax Fiber

Treatment per acre	St Constant 1951–1952	Maskinongé 1952–1953	L'Acadie 1953
	lb./ac.	lb./ac.	lb./ac.
Check—No treatment	918·6	355·4	371·2
2–12–10, 500 lb	914·1	494·6	363·7
Muriate of potash, 100 lb	888·0	453·3	341·1
Ammonium nitrate, 100 lb	860·9	322·2	491·5
Superphosphate 20%, 300 lb	866·2	372·6	302·3

In these studies there was no significant effect from the fertilizers on the yield of fiber flax on Rideau clay at St.-Constant. On the Maskinongé Station, muriate of potash has had a marked effect on the yield. On the gravelly loam soil at L'Acadie, nitrogen has given substantial increase. The striking point in these results is the difference in the basic potential of the three soils for flax fiber production. The soil at St.-Constant without any fertilizer treatment gave double the yield obtained at either Maskinongé or L'Acadie and none of the chemicals applied appreciably affected this relationship. These results are indicative of the desirability of adapting crops to soils best suited for their production.

The Fertilization of Cover Crops for Grazing

Cover crop production is being studied on the Claresholm Substation in the southern part of Alberta. The effect of fertilizing this crop has been tested in 1951 and 1952. In 1951 a 10 pound per acre application of nitrogen gave more rapid early growth, but an overall decrease in yield. A 50-pound per acre application of 16-20 increased the yield of dry matter by 600 pounds over the 1,543 pounds per acre produced by the unfertilized crop. Fifty pounds of 11-48 increased the yield by 477 pounds of dry matter over the check plot yield. In addition to the increased yield of dry matter the plot receiving 50 pounds of 16-20 per acre produced 80 pounds per acre more protein than did the check plot. In a similar experiment conducted in 1952, no yield increases were recorded from any treatment. The lack of crop response in 1952 may be partly explained by the relatively dry fall weather conditions.

Fertilizer Studies in the Farm Rotation

The conduct of soil fertility studies in the mixed and livestock-farming areas of Canada presents certain problems that are not usually encountered in the purely grain-producing areas of the Prairie Provinces. In the main these soils are lower in natural fertility. The question of previous management exerts a profound effect and an experiment conducted at two locations on identical soil types can give quite different results due to this factor. Previous manurial and rotational practices can have a definite effect on the physical properties of the soil and even where fertility is low the response to chemical treatment can be negative because of this factor. Results of the many experiments conducted on Illustration Station farms in these areas indicate that for best results the physical conditions of the soil must be maintained through good cultural practices such as crop rotations that include forage crops if the maximum response to fertilizer treatment is to be obtained.

In the studies that have been conducted on Station farms in the Eastern Provinces and British Columbia fertilizers have been applied to all crops grown. In long rotations the residual effect of inital fertilization on succeeding crops in the rotation is important. This residual effect may be prolonged in some soils and of relatively short duration in others. This aspect of fertility work is brought out by the selected cases dealt with in the following section

The District Experiment Substation at Mindemoya, Ont., is located on silty soils developed from deposits in glacial Lake Algonquin. Fertilizer formulae studies have been conducted on this soil since 1946 in connection with a five-year rotation of swedes, grain, and three years of hay. The fertilizers were applied to the swede turnip crop. The results summarized in Table 10 indicate the need for an increased level of phosphorus in fertilizer applied to this soil. Other studies on this farm show a pronounced effect from increasing the rate of application of 2-12-6 or 4-24-12.

TABLE 10.—The Effect of Varying Rates of Application of Nitrogen, Phosphate, and Potash on the Yield of Swede Turnips, Oats, and Hay at Mindemoya, Ontario, 1946-1953

Treatment per acre	Average yield per acre		
	Swede turnips 2 crops	Oats 2 crops	Mixed hay 5 crops
	tons	bu.	tons
10 lb. Nitrogen with P_2O_5 and K_2O	12·71	66·2	2·39
20 lb. Nitrogen with P_2O_5 and K_2O	12·90	66·3	2·30
30 lb. P_2O_5 (Phosphate) with N and K_2O	12·27	62·8	2·33
60 lb. P_2O_5 (Phosphate) with N and K_2O	12·91	66·5	2·29
90 lb. P_2O_5 (Phosphate) with N and K_2O	13·24	69·5	2·41
30 lb. K_2O (Potash) with N and P_2O_5	12·74	66·3	2·31
60 lb. K_2O (Potash) with N and P_2O_5	12·87	66·3	2·38

In a similar study, in which the fertilizers were applied to the first year of mixed hay at Dayton, Ont., there was a marked response to fertilizer application. Fertilizers high in nitrogen and low in phosphate and potash, such as 6-6-6 did not give as good yields as a formula such as 3-18-6, nor did a formula high in potash and low in nitrogen such as 3-18-12. The best yield increase was obtained from a 6-18-12 formula.

A three-year study at Launay in northern Quebec, revealed that 6-18-12 gave the greatest increase in the yield of oats when applied to that crop seeded down with grasses and legumes. However, the greatest yield of the succeeding hay crop was obtained from a 3-12-6 formula. When applying fertilizers to a cereal crop seeded down to hay it may not always be advantageous to produce a heavy crop of grain because the heavier crop of grain may shade the seedlings severely enough to reduce their yield in succeeding years. This same study laid down at Matheson, Ont., shows 6-18-6 to give the highest yield of oats, with 6-18-12 and 3-12-12 giving the greatest increase in the yield of hay. At Amos, Que., 6-18-6 gave the highest yield of oats while 3-18-6 gave the best yield of hay. It may be emphasized that in not one of these tests did the fertilizer giving the best oat yield also produce the best hay yield.

TABLE 11.—Response of Oats in Eastern Ontario to Various Levels of Nitrogen, Phosphorus, and Potassium 1951

Treatment per acre	Yield of oats per acre				
	Chapeau	Bloomfield	Caledonia Springs	Lyn	Williams-town
	bu.	bu.	bu.	bu.	bu.
Check (no nitrogen, phosphate or potash)	38·0	21·9	40·3	75·0	44·9
0 lb. N (Nitrogen) with P_2O_5 and K_2O	39·5	37·3	.....	.....	.....
15 lb. N (Nitrogen) with P_2O_5 and K_2O	52·0	58·3	.....	.....	.....
30 lb. N (Nitrogen) with P_2O_5 and K_2O	46·3	53·5	52·1	86·0	69·7
60 lb. N (Nitrogen) with P_2O_5 and K_2O	.....	.....	51·1	87·2	72·7
0 lb. P_2O_5 (Phosphate) with N and K_2O	37·1	49·2	.....	.....	.....
60 lb. P_2O_5 (Phosphate) with N and K_2O	49·8	49·8	46·2	82·3	71·2
90 lb. P_2O_5 (Phosphate) with N and K_2O	50·9	50·1	.....	.....	.....
120 lb. P_2O_5 (Phosphate) with N and K_2O	.....	.....	56·7	91·8	68·2
180 lb. P_2O_5 (Phosphate) with N and K_2O	.....	.....	51·8	85·8	74·3
0 lb. K_2O (Potash) with N and P_2O_5	46·4	45·2	.....	.....	.....
30 lb. K_2O (Potash) with N and P_2O_5	50·7	52·4	.....	.....	.....
60 lb. K_2O (Potash) with N and P_2O_5	40·8	51·5	48·7	86·3	74·2
120 lb. K_2O (Potash) with N and P_2O_5	.....	.....	54·5	86·9	68·2

The variable nature of crop response to fertilizer on the different soil types encountered is pointed up in the results of a study conducted on oats throughout eastern Ontario in 1951. While 6-12-12 gave considerably improved yields on Carp clay loam soil at Lyn, the increase was not significant*. At Williamstown, Ont., on Castor silt loam, fertilizers significantly increased the yield and 3-18-6 gave the greatest yield increase. At Chapeau, Que., on Chapeau clay, increased levels of phosphorus in relation to nitrogen and potash gave significantly greater yields. At Bloomfield, Ont., on Hillier clay loam, increased levels of nitrogen in relation to phosphorus and potash effected yield increases. At Caledonia Springs, Ont., on a heavy clay soil no one treatment provided a statistically significant yield increase. A summary of these studies is presented in Table 11.

A review of these selected studies and others that are conducted throughout Eastern Canada and British Columbia emphasizes the inherent differences between specific areas. While phosphorus deficiency is widespread the requirement for higher levels of other fertilizer elements is less general.

WEED CONTROL STUDIES

Established cultural practices continue to form the basic method of weed control on Illustration Station farms. However, the advent of selective chemical weed sprays has provided a more effective means of controlling many weeds. The use of these materials has been studied to determine the effect of various rates of application on different weed species, crop yields and newly seeded clovers and grasses. The effect of 2, 4-D on the various weed species has been quite well established and publicized. The effect on crop yields and new seedings of clover has been investigated on selected Illustration Station and District Experiment Substation farms.

The Effect of 2,4-D and M.C.P. on the Yield of Cereals.

During a four-year period ended in 1952 the effect of applying 2,4-D at various rates to wheat crops in the proper stage of growth was studied on four District Experiment Substations in the Scott, Sask., District. Two-, four-, six-, and eight-ounce rates of the amine and ester formulations were tested. The average yields of wheat obtained under various treatments during the four-year period are shown in Table 12.

TABLE 12.—The Effect of Various Rates of Application and Formulations of 2, 4-D on the Yield of Wheat on Four Stations in the Scott, Sask., Supervisory District, 1949-1952.

Treatment per acre	Yield of wheat per acre
	bu.
Amine—2 oz	25·4
Check	23·8
Amine—4 oz	24·0
Amine—6 oz	24·8
Check	25·1
Amine—8 oz	25·3
Ester—2 oz	25·3
Check	25·4
Ester—4 oz	25·7
Ester—6 oz	24·4
Check	24·2
Ester—8 oz	21·8

*Significant means that the odds against the results being due to chance alone exceed 19:1.

The amine formulation had no adverse effect on wheat yields even at the 8-ounce rate. However, the ester formulation caused some damage at the 8-ounce rate; and there was some loss of crop vigor and a percentage of misshapen heads at the 6-ounce rate. It should be emphasized that these spray tests were conducted on weed infested crops. There are very definite indications that crop response to spray applications is directly dependent on the degree of weed infestation and the control achieved. The spraying of weed-free cereal crops has no marked beneficial effect on yields and may have a pronounced deleterious effect at heavy rates of application. An 8-ounce application of low volatile ester on a wheat crop slightly infested with weeds reduced the yield from 50·6 to 44·2 bushels per acre at Pincher Creek, Alta., in 1952. However, the spraying of weed infested crops with the resultant decrease in competition for nutrients, moisture, etc., can provide for greatly increased yields. As an extreme example of this effect the results obtained at Paddockwood, Sask., in 1950, show that in an oat crop, heavily infested with perennial sow thistle it was impossible to measure any yield on the unsprayed plots yet on those sprayed with 6 ounces of the ester formulation a yield of 25·0 bushels per acre was recorded. Indications are that no appreciable crop loss results from the judicious use of 2,4-D and that substantial yield increases may be obtained. Quite similar results were obtained with M.C.P. at rates effective in weed control.

The Effect of 2,4-D on the Stand of Newly Seeded Legumes

During the period 1950 to 1953 tests were laid down on four stations in the Mindemoya, Ont., supervisory district to determine the effect of spraying cereal nurse crops for weed control on newly seeded alfalfa and red clover. The effect of a 4-ounce per acre application of the butyl ester formulation ranged from no reduction to a 40 per cent reduction in legume stand. The 8-ounce application caused from 10 to 50 per cent reduction in the fall stand of legumes while the 16-ounce rate caused up to 80 per cent decrease in legume stand. It was found, however, that the legume population gradually recovered as did the population of such pernicious weeds as perennial sow thistle. The weeds showed greatest recovery the year after spraying while legume recovery was apparent following the second year after seeding. Where the spray application was not sufficiently heavy to seriously reduce the legume stand there was a satisfactory net decrease in the weed population.

The Control of Volunteer Rye Grass in Red Clover Seed Production

In 1952 and 1953 experiments were conducted at Cloverdale, B.C., to determine means of controlling volunteer rye grass (*Lolium multiflorum*) in double-cut red clover for seed production, by use of IPC (Isopropyl phenyl carbamate). The IPC was applied both in the spring and in the fall and care was taken that the chemical made contact with the soil. All rates of IPC were applied in one gallon of aqueous solution per square rod. The results of this study are summarized in Table 13.

TABLE 13.—The Average Yield of Seed From Red Clover Treated with IPC to Control Volunteer Rye Grass—Cloverdale, B.C. 1952-1953

Treatment per acre (Acid equivalent)	Seed yield per acre	
	Fall treated	Spring treated
	lb.	lb.
3 lb. wettable IPC	.....	477
6 lb. wettable IPC	390	487
9 lb. wettable IPC	.....	490
Check (no treatment)	238	334

The data presented in Table 13 indicate that substantially increased yields of red clover seed can accrue from the control of rye grass through the use of IPC at the rate of 6 pounds of acid equivalent per acre. The fall applications gave two-year freedom from the rye grass while the spring application did not. It was also observed in this study that IPC effectively controlled stinking mayweed (*Anthemis cotula,* L.) but had no effect on timothy and orchard grass at the rates used.

Other Weed Control Studies

At Dalroy, Alta., and Armstrong, B.C., special studies are under way to determine the best cultural and chemical means of controlling hoary cress (*Cardaria* Spp., Desv.). Extensive experiments are conducted at Marsden, Sask., to determine economical methods of eradication and control of toadflax (*Linaria vulgaris,* L.). Among other special weed studies is one recently established at Avondale, Nfld., where the control of heath weeds in blueberries by variation in seasonal burning is being investigated.

CEREAL VARIETY TESTS

The Illustration Stations Division co-operates very closely with the Cereal Crops Division in the conduct of variety tests in all districts of supervision throughout Canada. The information obtained from these tests is used for the formulation of zoning recommendations and also as a means of evaluating new selections. New and improved varieties of cereal crops are tested and compared with standard varieties on 169 Illustration Stations and District Experiment Substation farms. In addition to regular variety tests special disease nurseries of wheat, oats, barley, and flax are maintained on selected stations. Samples from these plots are supplied to the Rust Research Laboratory for disease identification purposes.

Varieties that have proved superior in the different districts are seeded on a field scale and multiplied for local sale by the farmers on whose properties Illustration Stations and District Experiment Substations are operated. During the period 1948 to 1953, inclusive, distribution by sale of

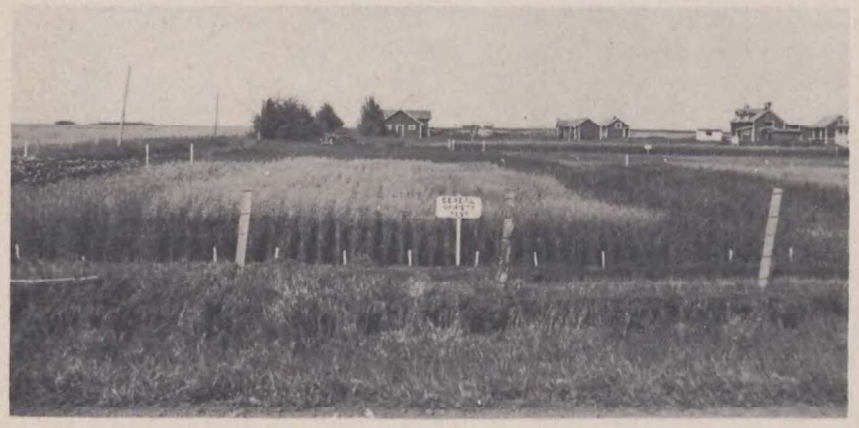


FIG. 7. Experimental plot area of the Illustration Station at Fairview, Alta., 1950 —Foreground—Project IS-06.05—Cereal Variety Test—Background—Project IS-02.10—The Effect of Chemical Fertilizers on Cereals.

improved varieties of cereals from station farms totalled 336,938 bushels. Twelve varieties of wheat have been introduced and multiplied on 90 station farms, namely the varieties Acadia, Cascade, Regent, Lee, Redman, Selkirk, Apex 2177, Thatcher, Saunders, Rescue 103, Chinook, and Sun; fifteen varieties of oats, namely Ajax, Beaver, Eagle, Abegweit, Fortune, Vanguard, Roxton, Exeter, Erban, Lanark, Rodney, Larain, Victory, Clinton, and Winter Turf have been introduced and multiplied on 110 station farms. The barley varieties Charlottetown No. 80, Fort, Montcalm, Vantage, Peatland, Velvon II, Olli, Warrior, Titan, Campana, Newall, and Olympia were tested and multiplied on 104 station farms.

Flax variety tests are conducted on 69 Illustration Stations and district Experiment Substations, including the testing of fiber flax varieties on 5 stations located in the districts of L'Assomption, Que., central Ontario, and Creston, B.C., and the testing of linseed flax varieties on 64 stations in the Prairie Provinces. From these tests the most promising of linseed flax varieties appear to be Rocket, Redwood, Redwing, Raja, and Marine. In the case of fiber flax, Stormont Gossamer L.26, Cirrus, and Norfolk are the most promising varieties.

FORAGE CROP STUDIES

During the period covered by this progress report the work on forage crops conducted on Illustration Station and District Experiment Substation farms has been directed to the determination of the most suitable grasses, legumes, and grass-legume mixures for hay and pasture production. Other aspects of forage crop work such as silage production have also been studied. The main lines of investigations are:

(1) Testing Mixtures for Hay or Pasture
(2) Adaptation of Grasses and Legumes to Varying Regional Conditions
(3) Grasses and Clover Species for Slough Land
(4) Field Corn Variety Tests

Grasses and Legumes for Hay and Pastures

Experimental work dealing with hay mixtures has been undertaken on 36 District Experiment Substations and 88 Illustration Stations. Many of these tests have been conducted in co-operation with the Forage Crops Division and represent an expansion of the work under way at the Experimental Stations throughout Canada. In this way it has been possible to evaluate the adaptation of new grass or legume varieties and to determine the zones in which they might be most advantageously grown.

British Columbia and Alberta

On Vancouver Island a mixture seeded at the rate of 5 pounds of red clover, 2 pounds of alsike clover, 5 pounds of Grimm alfalfa and 8 pounds of orchard grass per acre has given the highest yield in a hay-mixture test conducted on the Illustration Station farm at Duncan, B.C. The inclusion of meadow fescue in the mixtures at Alberni, Courtenay, and Duncan brought about increased yields. Orchard grass was valuable at Duncan and gave more second growth than other grass species. Common brome has yielded well in first-year stands but yields have fallen off rapidly in second- and third-year stands.

In the Agassiz district timothy is proving to be the best grass for combining maturity with yield on the Mara clay soil at Salmon Arm. It has shown up even to greater advantage on the bottom land clay at Mount Cartier. Brome grass has not been successful, being superseded by other grasses such as reed canary and timothy. It was also observed that Rhizoma alfalfa withstood periodic flooding better than any other alfalfa variety. On the District Experiment Substation at Creston, B.C., a test conducted during the period 1950-1952 comprised Ladak and Grimm alfalfa and ten grass-legume mixtures. The grass-legume mixtures have given higher yields than either of the alfalfa varieties sown singly. Brome and timothy were found to be the most suitable grasses under test and were more compatible with alfalfa than orchard grass from the standpoint of date of maturity. The mixtures containing alsike and red clover yielded higher than alfalfa alone and slightly lower than the alfalfa-grass mixtures.

A project was established in 1948 at Baldonnel, B.C., and McLennan in the Beaverlodge, Alta., district to determine the relative suitability and yielding ability of grasses and legumes, alone and in mixtures, for pasture on different soils and under varying climatic conditions as found in the Peace River region. The comparative yields of the various mixtures tested for pasture are presented in Table 14.

TABLE 14.—Yields of Pasture Swards in the Peace River District

Average Yields of Dry Matter per Acre

Species and rate of seeding	Baldonnel, 1949–53	McLennan, 1950–52*
	lb.	lb.
Brome 18	1,599	648
Creeping red fescue 8	1,482	585
Kentucky blue grass 12	1,146	511
Brome 8, C.R. fescue 5	1,560	554
Brome 8, Kent. blue grass 6	744	713
C.R. fescue 4, Kent. blue grass 6	1,829	468
Alfalfa 12	3,122	1,908
Brome 8, alfalfa 8	2,585	1,904
C.R. fescue 4, alfalfa 8	2,824	2,186
Kent. blue grass 4, alfalfa 8	2,270	1,858
Brome 4, fescue 4, alfalfa 4	3,087	1,973
Brome 4, K. blue grass 4, alf. 4	1,776	2,128
Fescue 4, K. blue grass 3, alf. 4	2,515	2,124
Brome 6, alf. 6, sweet clover 6	2,460	2,304

*No yield taken in 1949 and 1953.

At these two points in the Peace River district, alfalfa has proved to be an effective constituent of the pasture mixture with the largest increase obtained on Gray Wooded soils at McLennan. Creeping red fescue has been outstanding in these trials. It is a highly nutritious grass that maintains its quality from early to long after freeze-up, making excellent fall and winter pasture. When mixed with alfalfa it significantly outyielded 9 of the 14 swards at Baldonnel and was the second highest producer at McLennan. Brome, long the popular grass of the Peace River district, has been found less productive than creeping red fescue, especially from a pasture standpoint when seeded in a mixture. This was the case particularly at Baldonnel. Brome fails to supply good pastures in the autumn months by wintering off with the first killing frost. Kentucky blue grass has been a consistenly poor producer, both alone and in mixtures. The deep rich soil and ample moisture at Baldonnel proved most suited to the mixture of brome, alfalfa, and fescue, while at McLennan the highest yielding sward was brome, alfalfa, and sweet clover. The mixture containing the two legumes was a definite advantage on the Gray

Wooded soil at McLennan but did not significantly outyield the mixture of creeping red fescue and alfalfa which proved to be one of the most promising pasture swards in the test.

Saskatchewan

In the forage tests carried on in the Melfort, Sask., district of supervision, different varieties of grasses and legumes were tested singly or in mixtures, on nine stations farms. When considering the long-time averages, the outstanding yielders have been a mixture of brome and alfalfa at Carragana; alfalfa and crested wheat grass and alfalfa and western rye grass mixtures at Guernsey; alfalfa and brome and alfalfa and crested wheat grass mixtures at Snowden; alfalfa and Western rye mixture and Fairway crested wheat grass at Star City. Viking, Ladak, and Grim alfalfa sown in pure stands were the highest yielders at Henribourg.

Brome grass has been found to be the number one forage variety grown in the northern part of the Scott supervisory district of Saskatchewan. The fact that brome is a long-lived perennial and makes excellent pasture in the spring and early summer has increased its popularity. Crested wheat grass and alfalfa sown in combination yielded 4·39 tons per acre while a brome and alfalfa mixture yielded 4·71 tons of cured hay per acre on the Glenbush station farm in 1952. Crested wheat grass makes an ideal pasture in both early spring and late fall in the Brown, Dark Brown and Black soils of the Scott district. In another test conducted at Glaslyn, Sask., during 1950 and 1951, the Ladak and Viking varieties of alfalfa have consistently outyielded the Grimm variety by over 200 pounds of cured hay per acre, but there has been very little difference between the Viking and Ladak varieties.

A grass and legume mixture consisting of 6 pounds of common crested wheat grass and 10 pounds of Arctic sweet clover per acre was sown with wheat on three station farms of southeastern Saskatchewan, namely: Arcola, Wawota, and Yorkton. The eleven-year average yield was 1·22, 1·58, 1·83 tons of cured hay per acre, respectively. In another test at Yorkton, Arctic sweet clover has been grown for 15 years for hay production. It has been sown at 16 pounds per acre with a nurse crop of wheat. The long-time average shows a yield of 1·64 tons of cured hay per acre. An important advantage of sweet clover is that it can be readily worked into short rotations and has the ability to enrich the soil and improve its texture.

In a perennial forage test conducted on the Shackleton farm in southwestern Saskatchewan during the six-year period, 1947-52, the grass-Ladak alfalfa mixture has shown a definite advantage over straight grasses seeded singly. The grasses under test included brome grass, crested wheat grass, and intermediate wheat grass. Ladak alfalfa alone outyielded Grimm alfalfa by an average of 0·17 tons per acre and observations have shown the stand of Ladak to be considerably thicker than Grimm.

Manitoba

In southeastern Manitoba, an alfalfa variety test was laid down on the Lyleton Station farm in the spring of 1951 to study the adaptability and yielding ability of alfalfa varieties in that area. On the basis of one year's testing Ladak, Rhizoma, and M50 appeared to be well adapted to conditions at Lyleton. Ladak has significantly outyielded the Grimm variety. On the first cut, Ladak yielded more than Rhizoma, but on the second cut there was no significant difference in yield between them.

The results of experimental work dealing with the adaptation of various grass and legume mixtures in Eastern Canada indicate the variability that occurs in species performance.

Ontario

A test recently established on the District Experiment Substation at Fort William and on the Illustration Stations at Dryden and Kenora compared four selected seed mixtures with the usual farm mixture. Through two years, 1951 and 1952, this experiment has indicated that the best results may be expected from a seed mixture containing alfalfa 5 lb., red clover 5 lb., alsike 2 lb., and timothy 8 lb., per acre. Other species in the tests which have not shown to great advantage are ladino clover, brome, orchard grass, meadow fescue, and reed canary grass.

Results obtained at Mindemoya, Ont., in the Manitoulin Island District show that Ladak alfalfa and Climax timothy could replace the common commercial varieties to advantage in that area. The results obtained from tests conducted on Illustration Station farms in eastern and central Ontario indicate that an alfalfa and brome mixture gives high yields of more easily cured hay.

Quebec

A summary of five years of work at Macamic, Que., District Experiment Substation indicates clearly that the single-cut red clover (Altaswede) is one of the most productive legumes available for that district when used in hay mixtures. It has shown more hardiness and, in comparison of complete stands, has outyielded the double-cut red clover by 500 pounds of dry hay per acre.

In the L'Assomption, Que., district, mixtures containing brome and alfalfa also appeared promising on some selected areas. In the Lennoxville district ladino clover has given outstanding results in tests of hay and pasture mixtures. A mixture containing 8 pounds of timothy, 5 pounds of red clover, 5 pounds of alfalfa, and ¾ pound per acre of ladino clover has been found to be most productive. Among the hay mixtures tested the results obtained thus far in eastern Quebec prove the superiority of a seed mixture containing 15 pounds of brome, 5 pounds of alfalfa, 5 pounds of red clover, and 2 pounds of alsike clover per acre.

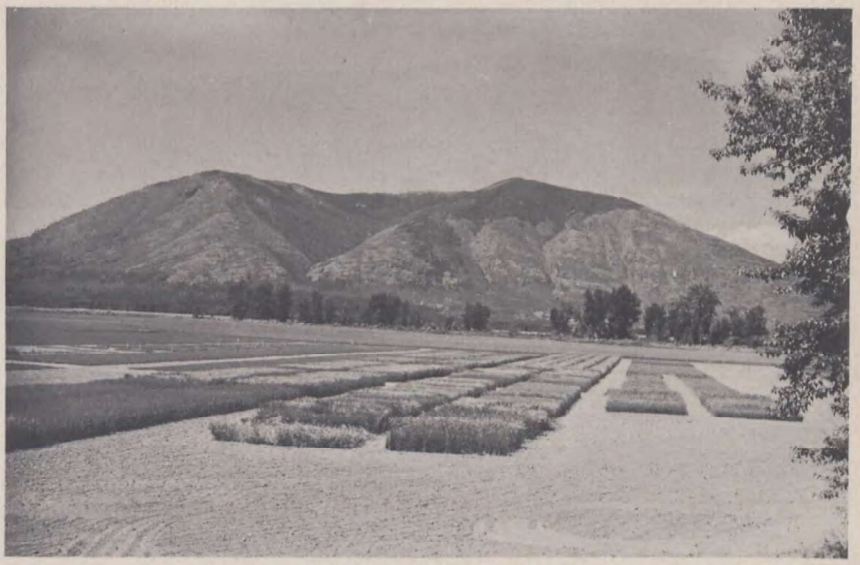


FIG. 8 General view of the experimental area of the Creston Experiment Substation, B.C., 1950, showing the hay mixture tests and the cereal rod row variety tests.

Maritime Provinces

In the Maritime Provinces, the best results with hay mixtures have been obtained using common species; namely, timothy, red clover, and alsike clover. On the well-drained and fertile soils of the Maritime Provinces, it has been found advantageous to add alfalfa seed in the amount of about 25 per cent of the mixture.

Forage Nurseries

An important part of the forage work on Illustration Stations and District Experimental Substations is the maintenance of a nursery where collections of grass and legume plants of forage value are grown to compare the performance of new varieties with that of standard forages and to study their adaptation under various climatic and soil conditions. The most promising varieties and species are selected for more detailed testing, singly or in mixtures, while those of least promise are discarded. Work of this nature was conducted on 27 Illustration Station and Substation farms in Eastern and Western Canada during the year 1953.

Varietal Test of Silage Corn

Field corn still occupies a place on many farms, especially in Eastern Canada, being grown for both ensilage and green fodder. During the period 1948-53, several varieties of corn, mainly hybrids, have been compared on 40 Illustration Station farms in British Columbia, Ontario, Quebec, and Prince Edward Island. The field corn tests have included such varieties as Longfellow, Algonquin, Wisconsin 7 and 275, Canada 150, 210, 240, 250, 355, 416, 531, 606, 625 and 696, DeKalb 65, Pride 45B, and Golden Glow.

In British Columbia the results of a randomized test conducted with seven forage corn hybrids at Armstrong and Salmon Arm have shown that both Canada 335 and DeKalb 65 were satisfactory in the several seasons that they have been under test. At Creston, eight hybrids tested during the period 1949-51, produced average yields ranging from 8·58 tons of green fodder per acre for Canada 250 to 17·29 tons for Canada 606.

In Ontario tests through seven years on the District Experiment Substation at Fort William have shown that the climate of the district is too cool for field corn. In some seasons a fair yield of fodder may be harvested but seldom do the ears mature. On the station farms at Mindemoya, Gore Bay, and Noelville, Canada 606 has produced the highest yield of fodder, followed closely by Canada 531. While corn is not extensively grown in the Manitoulin Island district, it has been found that forage corn can be grown to advantage on those farms. Such a crop may be used in the farm program to furnish abundant, succulent forage for beef or milk-producing herds. In the eastern and central Ontario district, the most promising hybrids for forage were Canada 606, Canada 531, and K300.

In Quebec, the most important center of forage corn production is in the L'Assomption district. In a test conducted on ten Illustration Station farms, the variety Canada 606 recorded the biggest yield followed closely by Algonquin. Canada 606 has been most productive at Batiscan, Lachevrotiére, St-Constant, St-Damase, St-Jacques, and St-Simon, while the variety Algonquin has been the top yielder at L'Acadie, Mont-Rolland, and St-Etienne-des-Grés. In the Ste-Anne-de-la-Pocatière district, the variety Wisconsin 275 has been the top yielder at Luceville, Notre-Dame-du-Lac, St-Paul-de-Montminy, and St-Pierre-d'Orléans.

In Prince Edward Island, a study of the long-time average yields of silage corn on five Illustration Station farms has found Algonquin outyielding Longfellow by 1·38 tons of green fodder per acre. Twenty-four tests covering a four-year period show Canada 240 outyielding Algonquin by 0·93 tons per acre.

While the yields quoted are on the basis of green rather than dry matter, the tests conducted have permitted the comparison of the several varieties under test, and their range of adaptation for specific areas.

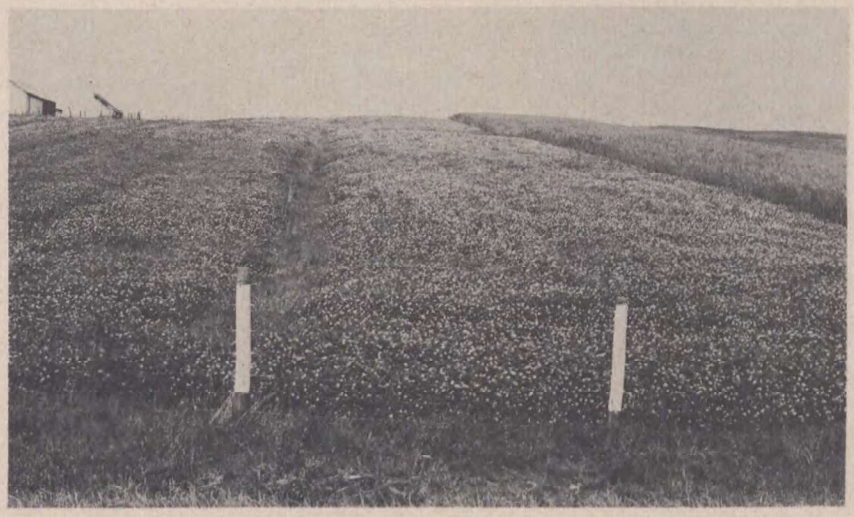


FIG. 9. The use of ladino clover at ¾ pound per acre in the hay seed mixture supplies good pasture forage when pasture fields are getting low in August. This picture shows a second growth of ladino clover on August 4, 1950, at the Illustration Station, Wotton, Que.

PASTURE INVESTIGATIONAL STUDIES

Pasture Fertilization

Since the publication of the Divisional Report for 1938-47, more than 200 annual yield records have been obtained from a study designed to determine the effect of surface applications of chemical fertilizers on permanent pasture swards and since the experiment was established in 1944 a total of 666 annual yields have been recorded. In this study, the effect of phosphorus alone is compared with that of phosphorus and potash, and nitrogen, phosphorus, and potash. Phosphorus is applied as superphosphate 20 per cent at the rate of 600 pounds per acre every three years. Potassium is applied as muriate of potash 50 per cent at the rate of 120 pounds per acre every three years, and nitrogen as ammonium sulphate 20 per cent at the rate of 100 pounds per acre each year. A fourth plot in this experiment receives 100 pounds of ammonium sulphate, 600 pounds of superphosphate 20 per cent and 120 pounds of muriate of potash each year while on a fifth plot the minerals are applied at one-third of this rate each year with the ammonium sulphate applied at 100 pounds per acre. These five treatments are compared with an unfertilized check plot. Yields are procured from yard-square pasture cages on each plot. At each clipping visual estimates of the botanical composition of the swards are recorded.

TABLE 15.—Yield of Pasture Herbage in Tons Per Acre Green Weight and the Annual Variability in Yield Obtained in Six Canadian Provinces—1944 *to* 1953, on Illustration Stations

Province	Number of tests	Treatment per acre											
		100 lb. amm. sulp. 600 lb. super. 20% 120 lb. mur. of pot. every 3 years		600 lb. super. 20% 120 lb. mur. of pot. every 3 years		600 lb. super. 20% every 3 years		100 lb. amm. sulp. 200 lb. super. 20% 40 lb. mur. of pot. every 3 years		100 lb. amm. sulp. 600 lb. super. 20% 120 lb. mur. of pot. annually		Check	
		Yield	C.V.	Yield	C.V.	Yield	C.V.	Yield	C.V.	Yield	C.V.	Yield	C.V.
		tons	%	tons	%	tons	%	tons	%	tons	%	tons	%
Prince Edward Island	42	11·99	39·9	11·14	44·3	10·33	45·4	12·56	42·2	15·81	45·9	7·66	54·4
Nova Scotia	108	12·57	30·8	11·62	28·6	11·54	30·7	11·81	32·8	14·15	32·4	5·67	37·3
New Brunswick	81	9·13	26·8	8·03	30·6	7·48	26·3	9·24	26·8	11·02	28·5	5·14	31·1
Quebec	278	9·07	20·9	8·36	23·5	7·75	23·2	8·78	20·0	10·08	18·7	5·60	23·3
Ontario	123	8·81	22·1	8·13	20·6	7·56	22·7	8·82	19·4	10·02	23·3	5·10	23·5
British Columbia	34	14·48	46·4	12·02	45·6	12·02	45·8	13·65	48·7	16·00	45·5	9·53	48·5
Average	666	10·04	.....	9·16	.....	8·68	.....	9·81	.....	11·49	.....	5·80	

The yield data from these studies are presented in Table 15 and represent green yields per acre. The Coefficient of Variability (C.V.), which is a rough measure of the year-to-year variations in yields, is also presented. The C.V. are expressed in percentages and thus the greater the variation, the higher the C.V.

On the basis of the data derived from 666 records, phosphorus alone has produced a yield increase of 2·88 tons of green herbage over the unfertilized check yield of 5·80 tons. The addition of 120 pounds of muriate of potash per acre to the superphosphate application has further increased the yield by 0·48 tons. An annual treatment of 100 pounds of ammonium sulphate as a supplement to the minerals has given a further yield increase of 0·88 tons per acre. No advantage in terms of yield was derived from making light annual applications of fertilizer, rather than heavier applications every third year. The heavy annual application of minerals has given a yield increase of over 1·45 tons of green herbage over the application of one-third of these nutrients every three years with the same application of nitrogen. Besides increasing the yield of herbage the application of fertilizers has had a marked effect on the botanical composition of the sward and thus the quality of forage. The greatest proportion of clover was found on those plots that were treated with phosphate and potash and the heaviest weed population on the unfertilized check plots.

While there is a general response of pastures to fertilizer treatment considerable difference occurs between individual pastures on different soils or under different climatic conditions. At some locations the influence of any one nutrient may be much more or less pronounced than is indicated by the overall averages. On the basis of provincial averages, it was found that nitrogen gave an increase of 2·46 tons per acre in British Columbia and only 0·68 tons in Ontario. The greatest yield increase from potash occurred in Prince Edward Island, being 0·81 tons per acre, and the least in British Columbia, where no increase was recorded. Yield increases for phosphate were general, with the greatest average increase of 5·87 tons occurring in Nova Scotia. The application of nitrogen has had a much more marked effect in reducing the clover

Fig. 10. Pasture improvement study at Nanaimo, B.C.

population in pastures in British Columbia than elsewhere in Canada. A variation in results also occurs between the station farms within each province and is occasioned by differences in species of herbage, soil type, local weather conditions, and other factors governing crop production.

A further study of the data in Table 15 indicates that there is considerable variability in pasture production from season to season on permanent swards. While the results from the Maritime Provinces and British Columbia record higher average yields than Ontario and Quebec, variation from year to year as measured by the Coefficient of Variability is considerably greater. While fertilization of permanent swards has given marked yield increases, it has had very little effect on the reduction of yield variations from season to season. It would appear, therefore, that climate has a more specific effect on pasture production from year to year than has fertilization particularly where native species are involved. It is apparent on the Prince Edward Island Illustration Stations that the greatest reduction of seasonal variation on any plot was of the order of 14·5 per cent, however the range of variability on the unfertilized check plots was 54·4 per cent. When the average data for all tests are evaluated it appears that no fertilizer treatment can be singled out as being the most effective as a means of controlling seasonal variation of production.

Response of Pasture to the Surface Application of Lime

The effect of ground limestone on the yield of pasture herbage is studied on ten Illustration Stations in the Maritime Provinces in conjunction with the regular study of pasture fertilization. In the tests, ground limestone was applied at the rate of two tons per acre across the fertilizer plots. The results obtained during the period 1948-52 indicate that the application of two tons of limestone has apparently reduced the yield of herbage on the Urbinville Station farm in Prince Edward Island. The average yield obtained on the limed plot was 7·85 tons of green herbage per acre in comparison with 8·81 tons on the unlimed plot. On the other hand, there has been an overall average yield increase of 1·10 tons of green herbage per acre on the nine station farms in Nova Scotia, with the five-year average yield being 7·69 tons per acre on the limed plot and 6·59 tons on the unlimed area. Response to lime has been more specific on the naturally more productive pastures of western Nova Scotia.

Pasture Renovation

From the foregoing discussion of the results of studies of surface application of fertilizers and limestone, it is apparent that pasture response is variable. Since ground limestone and phosphorus carriers are relatively immobile in the soil and because the plant population or soil organic matter status might be limiting the effect of fertilizers and limestone, it was deemed advisable to study their effect when combined with manure and different cultural practices. These studies are active on sixteen stations in Quebec and the Maritime Provinces. The studies are varied in design from one district to another to adapt them to local problems.

In an experiment under way on four Illustration Stations in the Lennoxville, Que., supervisory district, rotational pasture is compared with native sod, both of which are fertilized and unfertilized. The fertilizer treatment applied to the native sod is the same as in the rotational pasture. The rotation followed is of four years' duration. Oats are seeded to timothy and ladino and all four crops are pastured. Yields are recorded on the first, second, and third years of the timothy and ladino pasture. The yield data are presented in Table 16.

TABLE 16.—Pasture Renovation Trials in Lennoxville Quebec District 1951-53

Yields in Tons of Green Herbage per Acre

Station	Field Number	Renovated pasture *Fertilization* First year Manure 12 tons 2-12-6,600 lb. Second year 2-12-6,400 lb. *Pasture mixture* Timothy: 8 lb. Ladino: 2 lb.			Old sod *Fertilization* (same as renovated pasture)			Old sod No treatment		
		First year	Second year	Third year	First year	Second year	Third year	First year	Second year	Third year
Pintendre	1	22·12	13·59	10·81	14·98	12·36	7·33	9·56	7·60	5·67
	2	19·30	11·79	.....	.....	.....	.....	.....	.....	.....
	3	11·23	.....	.....	.....	.....	.....	.....	.....	.....
St-Flavien	1	23·74	13·18	7·94	16·48	14·40	7·38	8·30	3·17	3·10
	2	21·26	10·81	.....	.....	.....	.....	.....	.....	.....
	3	20·04	.....	.....	.....	.....	.....	.....	.....	.....
St-Gregoire	1	28·07	16·13	10·43	9·90	10·40	9·37	5·37	6·77	5·29
	2	13·99	10·58	.....	.....	.....	.....	.....	.....	.....
	3	13·76	.....	.....	.....	.....	.....	.....	.....	.....
Wotton	1	11·50	12·11	8·18	5·94	5·86	7·26	4·96	2·72	6·01
	2	11·47	12·10	.....	.....	.....	.....	.....	.....	.....
	3	10·81	.....	.....	.....	.....	.....	.....	.....	.....
Average		17·27 (12)	12·54 (8)	9·34 (4)	11·83 (4)	10·76 (4)	7·84 (4)	7·05 (4)	5·07 (4)	5·02 (4)

Average 1951—21·38
Average 1952—16·51 13·75
Average 1953—13·96 11·32 9·34

Note: Field No. 1 was first-year pasture in 1951.
Field No. 2 was first-year pasture in 1952.
Field No. 3 was first-year pasture in 1953.

From these data it will be noted that fertilization alone substantially increased the yield at Pintendre, St-Flavien, and St-Grégoire but had a relatively minor effect at Wotton. Results to date indicate that greatly increased pasture production can be obtained from plowing old pastures and re-seeding to regionally adapted, high yielding mixtures. It will be noted that the productivity of rotational pasture decreases relatively constantly following the first year after seeding. First-year pasture yielded on the average 17·27 tons per acre as compared with 12·54 in the second year and 9·34 tons in the third year. It will be observed that the third year after seeding the yield of the rotational pasture has not greatly exceeded the yields of fertilized native sod.

Studies of a similar nature have been conducted in the Fredericton, N.B. and Nappan, N.S. Supervisory Districts. These have indicated that, under certain conditions where the sward has seriously deteriorated and the soil has sufficient depth and moisture, re-seeding, liming, and fertilization of pastures is desirable. However, in cases where the proper species are present, fertilization and the adjustment of soil pH can give as satisfactory results as complete renovation.

POTATO VARIETY TESTS

Varietal adaptation studies are conducted on 24 Illustration Station farms, throughout the five Eastern Provinces, Saskatchewan, and British Columbia. During the three-year period 1951 to 1953, inclusive, improved varieties of potatoes have been introduced and multiplied on 65 station farms. Varieties such as Canso, Keswick, Kennebec, and Teton have been introduced on 42 widely scattered station farms in the Eastern Provinces. Columbia Russet, Pontiac, Canso, Keswick, Wawota, Pawnee, Bliss Triumph, Canus, Early Ohio, Early Carter, Netted Gem, Warba, and Burbank have been successfully introduced on 23 station farms in the Prairie Provinces. The general importance of this crop, due to the fact that it is grown on almost every farm, has necessitated detailed studies of the potato growing enterprise. Sales of Foundation stock and certified seed potatoes grown by operators of Illustration Stations to farmers in surrounding districts totalled 105,760 bushels during the six-year period 1948 to 1953, inclusive.

FIG. 11. Project IS-10-05—Potato Variety Test at the Illustration Station of Fairview, Alta., 1950.

CRANBERRIES

Cranberries are native to many areas in the Eastern Provinces. In New Brunswick alone production each year has varied from a low of 20,000 pounds to a high of 275,000 pounds and the average production in the past ten-year period has been 130,000 pounds per year with an average value of 18 cents per pound. As a secondary source of income on farms where suitable areas are available, this crop can become a profitable sideline. Investigational work on cranberry production was initiated on the Illustration Station at Cumberland Point, N.B., in 1941. This farm, located on the southwest shore of Grand Lake, with suitable low-lying areas on the lake shore and with a comparatively long frost-free period, provided an excellent site for the establishment of a cranberry bog. In co-operation with the owner of the farm, work was started in the fall of 1941 and this project has been the source of considerable information with respect to cranberry bog establishment and management, suitable varieties, weed control, and insecticides. This latter phase of the study is conducted by the Fruit Insect Laboratory, Fredericton, N.B.

The actual cost of preparing and planting the bog at Cumberland Point was approximately $650 per acre. It is not unreasonable to assume that the preparation of a bog will cost in the vicinity of $1,000 per acre under present conditions particularly if done entirely by hand labor. While methods of bog preparation have not changed materially in recent years, a few innovations conceivably might reduce costs, especially with respect to the preparation of larger areas. Where depth of soil and drainage permit, a bulldozer can be used for turfing and levelling. Similarly, ditching can be done with a "clam shell" or scoop type of mechanical dredge. A new system of planting that involves putting the vines through a straw cutter, then scattering them in profusion over the prepared bog and working them in with a disk harrow, has proved even more successful than hand planting. This new system should reduce the labor cost for planting, although the cost for vines, if purchased, would undoubtedly be increased. Sprinkler systems, as opposed to flooding, is another innovation that sometimes reduces the cost of dyking and levelling. On the other hand, the installation of this equipment would add to the initial investment.

Yield to the end of 1952 for the eleven-year period has been 22,522 pounds per acre with a value of $5,180 per acre. Cost of operation, being estimated at $2,909 per acre for the eleven-year period 1942-1952, leaves a total net return for the period of $2,270 or $206 per acre, per year. In interpreting these figures, it should be pointed out that the period included four years immediately following planting during which there was no yield. The bog is now in excellent condition, and it would appear from these data that with a satisfactory location, along with good management, cranberry growing can be a profitable enterprise.

Some restricted variety studies have been conducted at Cumberland Point. The bog was planted to the two varieties most commonly grown in the Cape Cod district of the United States, Early Black and Howes. Of the two, the Early Black variety, because of its earlier maturity and superior color, has been considered the most satisfactory for local conditions. The Howes variety has been a heavier yielder, however, and is reported to stand up better in storage than Early Black.

Weed control is a problem in connection with cranberry culture that can be expensive if the bog is not carefully prepared and suitable measures not adopted following planting to control weed growth. White kerosene has been found to be very effective in controlling the growth of plants of the grass family. Under the conditions experienced at Cumberland Point, good

control has been obtained on two-thirds of an acre by applying 45 gallons per year. The method of procedure used is to spot spray the clumps and patches where weeds are becoming established.

ESTABLISHMENT OF FARM SHELTERBELTS

The planting of farm shelterbelts has always been encouraged on Illustration Station and Substation farms. The value of a good shelterbelt to a farm is difficult to measure in monetary terms but the benefits are apparent in the enhanced appearance of the farmstead, the protection afforded from winds, especially in the Prairie Provinces, and the favorable location that is provided for the farm garden and orchard. Both deciduous and coniferous trees have been supplied to the station farms from the Forest Nursery Station at Indian Head, Sask. The establishment of many field shelterbelts on Illustration Stations took place largely in the period 1935 to 1946, but additions and renovations have been carried out subsequently. From 1947 to 1953, inclusive, over 26,000 additional trees and shrubs have been planted on stations in the three Prairie Provinces. Plantings have consisted largely of caragana, but other deciduous trees and shrubs such as maple, ash, poplar, elm, birch, willow, and lilac have been used. Coniferous trees favored for prairie shelterbelts are white and blue spruce, and various pines and larches.

LIVESTOCK PRODUCTION

The importance of livestock and livestock products in the overall economy of the Illustration Station and District Experiment Substation farms is shown by the fact that during the period 1948-52, there were only two districts of supervision in which cash receipts from this source comprised less than 20 per cent of total farm revenue. These two districts are both in the specialized grain growing area of western Saskatchewan. In 17 of the 23 districts in Canada (excluding Newfoundland), income from livestock and livestock products was more than 40 per cent of the total. However, the value of the investment in livestock per man-equivalent during the period 1948-52 was considerably higher on the prairies than in the other regions of Canada. The average investment per man-equivalent for the Prairie stations amounted to $2,938 as compared with $1,956 for Eastern Canada and British Columbia. These differences in the average investments reflect the labor-consuming nature of the predominately dairy enterprise as found in the Eastern Provinces and British Columbia contrasted with the beef cattle production of the Prairies. The Lacombe district of central Alberta showed the heaviest investment in livestock per man-equivalent of all the districts, a total of $6,732. The smallest investment in these terms was also on the Prairies where, in the Peace River district, it amounted to only $910 per man-equivalent.

The livestock enterprises on Illustration Stations and District Experiment Substations are conducted with the objective of developing high quality herds and flocks that will make effective contributions to farm income. While these farms are not organized to provide a large volume of breeding stock for sale, nevertheless any excess production that they may have over their own requirements finds a ready market in the immediate district. In the case of dairy and beef cattle, operators are encouraged to maintain high quality purebred herd sires. Milk production records are also kept in certain dairy herds and the selection of individual cows as foundation stock is based on production and

breed type. During the six-year period under review, the Illustration Stations and Substations supplied 2,211 head of cattle, in the form of sales for breeding purposes, to other farmers. A number of stations also maintain flocks of sheep which are headed by purebred rams. On these farms the factors affecting sheep production are studied and a plan of flock improvement through constructive breeding, feeding and management is followed. During this same period, a total of 289 sheep were sold off these stations for breeding purposes. With swine, selection of breeding stock is based on freedom from inherited deformities, prolificacy, growthiness, and grading records. Swine sales for breeding purposes off station farms from 1948 to 1953, inclusive, totalled 1,717 head. Poultry work is designed to promote the maintenance of improved farm flocks. Sales from station flocks for breeding purposes during the six years under review comprised 14,723 cockerels, 23,655 pullets and 45,937 dozens of hatching eggs.

FARM BUSINESS STUDIES

A co-ordinated farm business study is conducted on all Illustration Stations and Substations. Each week every operator prepares a summary sheet outlining his revenues and expenses. At the end of each year a complete farm inventory is taken on each farm of the value of the operators' investment in land and buildings, livestock, machinery and equipment, feeds, seeds and supplies on hand. Information is also obtained on land utilization, production of crops and livestock products and farm indebtedness. In the Prairie Provinces the cost of producing cereal crops is studied and in British Columbia and some eastern districts, the costs of milk production are studied. Identical procedures are followed in all districts of supervision throughout the country thus providing data that permit studies of farming types and the effectiveness of experimental procedures under a great variety of conditions.

Sources of Farm Revenue

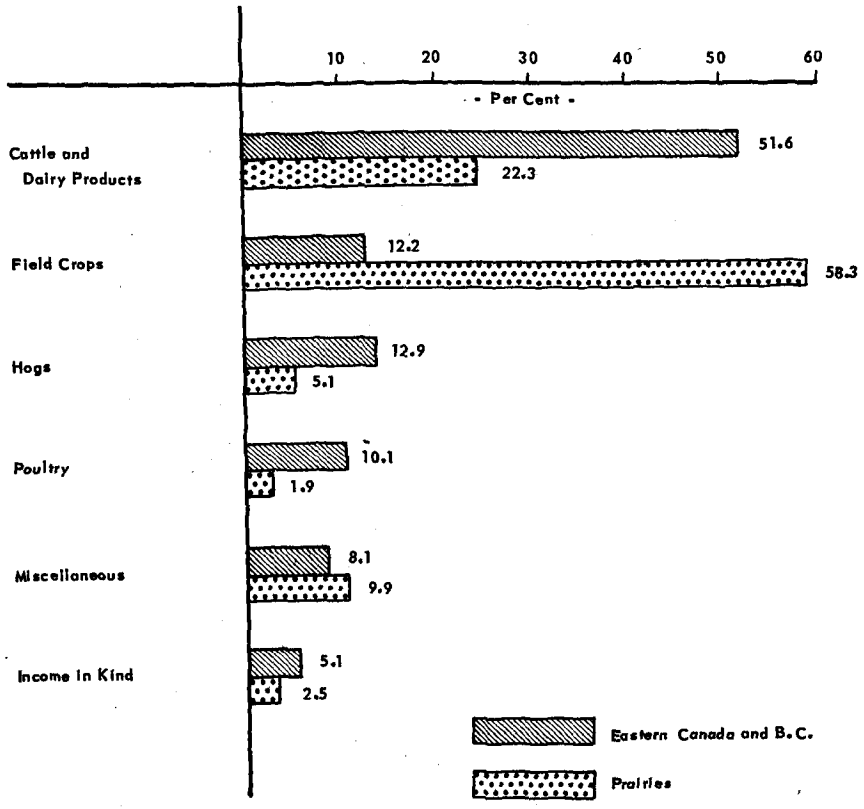
A study of the revenue of the Illustration Stations and Substations from the sale of farm products, miscellaneous farm revenue and income in kind for the period 1948-52 indicates the relative importance of the different farm enterprises in the various parts of Canada where work is being conducted. In broad terms of classification, the Eastern Provinces and British Columbia can be said to be livestock farming areas. Stations in these areas received 51·6 per cent of their farm income from the sale of cattle and dairy products. The Prairie Provinces and the Peace River district on the other hand received 58·3 per cent of the farm income from sales of field crops, (Fig. 12). A review of the district figures indicates that the stations in the Kentville district of western Nova Scotia received the greatest proportion of their income from cattle and dairy products, 70·1 per cent, while stations in the Swift Current district of southwestern Saskatchewan depended most heavily on field crop sales, which comprised 68·7 per cent of their farm income.

Hog production during this period accounted for 12·9 per cent of the farm income in Eastern Canada and British Columbia. This compares closely with the proportion of income from this source for the period 1943-47. Hogs were most important in the Lennoxville district of central Quebec supplying 20·9 per cent of the farm income. Hog sales on the Prairies accounted for only 5·1 per cent of farm income in 1948-52. This represents a considerable decline from the period 1943-47, when hog sales made up 12·8 per cent of the revenue. Hog sales in the Prairie Provinces were most important in the Lacombe district of central Alberta where 15·2 per cent of the farm income was derived from

Fig. 12.

SOURCES OF FARM REVENUE

Illustration Stations and District Experiment Substations
Five - Year Period, 1948-52



this source and also in the more northerly districts where they accounted for 13·3 per cent of the farm revenue in the Melfort area of northeastern Saskatchewan and 10·3 per cent in the Peace River district.

Use of Farm Capital

The proportionate investment in land and buildings, livestock, machinery, and equipment for each Illustration Station district in Canada (excluding Newfoundland) during the period 1948-52 is given in Table 17. During this period the value of the investment in land was held relatively constant at its assessed value. The value of the buildings and fences was based on the original assessed value depreciated according to the type of construction and expected life. Costs of repairs and maintenance were deducted to arrive at net depreciation.

TABLE 17.—Average Annual Capital Investment and Average Area Per Farm Illustration Stations and District Experiment Substations Five-Year Period, 1948-52.

Districts	Number of stations	Land and buildings		Livestock		Machinery and Equipment		Total capital	Area of farm	
		Amount	Percentage of total	Amount	Percentage of total	Amount	Percentage of total		Total	Cultivated
		$	%	$	%	$	%	$	ac.	ac.
Saanichton, B.C.	3	12,644	62·7	3,095	15·4	4,416	21·9	20,155	236	56
Agassiz, B.C.	4	8,824	60·8	3,069	21·1	2,627	18·1	14,520	90	57
Prince George, B.C.	5	9,035	43·2	5,885	28·1	5,990	28·7	20,910	330	133
Fort William, Ont*	4	9,192	58·8	2,939	18·8	3,500	22·4	15,631	224	101
Mindemoya, Ont.	6	15,084	49·2	8,030	26·2	7,550	24·6	30,664	428	146
Ottawa, Ont.	7	13,876	52·8	6,871	26·1	5,555	21·1	26,302	187	128
Kapuskasing, Ont.	6	9,086	53·1	3,292	19·2	4,747	27·7	17,125	144	102
L'Assomption, Que.	9	17,674	68·1	3,725	14·3	4,578	17·6	25,977	171	143
Ste-Anne-de-la-Pocatière, Que.	7	9,057	48·3	3,607	19·3	6·089	32·4	18,753	139	88
Lennoxville, Que.	12	8,992	50·9	3,470	19·6	5,202	29·5	17,664	176	75
Normandin, Que.	5	11,442	61·2	3,284	17·5	3,989	21·3	18,715	193	99
Fredericton, N.B.	11	6,397	47·9	2,795	21·0	4,149	31·1	13,341	170	67
Kentville, N.S.	4	7,174	45·1	5,537	34·8	3,202	20·1	15,913	198	69
Nappan, N.S.	5	8,802	56·2	3,335	21·3	3,530	22·5	15,667	169	56
Charlottetown, P.E.I.	7	8,450	56·0	3,051	20·2	3,587	23·8	15,088	186	92
Beaverlodge, Alta.	4	10,691	58·0	1,910	10·4	5,827	31·6	18,428	508	312
Lethbridge, Alta.	10	19,710	48·2	5,517	13·5	15,639	38·3	40,866	1,674	1,306
Lacombe, Alta.	6	14,576	36·8	13,463	34·0	11,551	29·2	39,590	1,216	622
Melfort, Sask.	7	11,253	53·6	2,733	13·0	7,016	33·4	21,002	469	318
Scott, Sask.	6	17,728	58·2	3,676	12·0	9,078	29·8	30,482	1,044	671
Indian Head, Sask.	9	19,782	49·7	6,412	16·1	13,593	34·2	39,787	1,107	759
Swift Current, Sask.	10	19,192	56·4	3,366	9·9	11,463	33·7	34,021	1,132	1,015
Brandon, Man.	12	13,851	50·5	6,014	21·9	7,554	27·6	27,419	614	434
All Districts	.....	12,813	52·2	4,626	18·8	7,103	29·0	24,542	523	350

*Not a 5-year average for one station.

The investment in the different categories of the farm capital is generally associated with the type of farming. The proportion invested in land and buildings ranges from a high of 68·1 per cent in the diversified farming area of the L'Assomption district, Que., to a low of 36·8 per cent in the beef cattle production area of Lacombe, Alta. Conversely the proportion of the investment in livestock is highest in the Lacombe, Alta., and Kentville, N.S. districts and lowest in the grain growing area of Swift Current. Proportionate investment in machinery is of course highest in the grain growing areas and lowest in the diversified areas. The Lethbridge district in southern Alberta had 38·3 per cent of the farm capital in machinery and equipment while the L'Assomption district, Que., had only 17·6 per cent.

Farm Efficiency

An analysis of the relative farm efficiencies was made of the Illustration Stations and Substations by districts using three types of measures: (*a*) scale (*b*) intensity (*c*) overall efficiency; the results of which are summarized in Table 18.

In terms of scale the Prairie stations are generally the largest. The average return to the *capital, all family labor and management* per farm for the Lethbridge district during the period 1948-52 was over $6,000. However, many of the Eastern stations showed higher than average returns and higher than those for many of the Prairie districts. The stations in the Normandin (Lake St. John) district of Quebec averaged over $3,000 in terms of this measure.

The measures of intensity used were: *investment per acre of cropland, gross receipts per acre of cropland and acres of cropland per man-equivalent.* In all of these measures the Eastern Canada and British Columbia districts, as a result of diversification, are much more intensified in their agriculture than the Prairie districts. Lethbridge, Alta., and Swift Current, Sask., were the least intensified of all districts, Lethbridge being lowest in two of the three measures used. The Saanichton district on Vancouver Island was the most intensified agriculturally in all three measures. The stations in this district derived 63·0 per cent of the farm revenue from cattle and dairy products. In terms of overall efficiency there was not too wide a difference between the Eastern Canada and British Columbia districts and the Prairie districts, the Prairie districts being only slightly higher on the average. This "overall measure of efficiency" used here included new capital expenditures for equipment as a part of the "inputs" while "total returns" are only in terms of cash receipts from all sources, hence this measure is lower than what would be obtained if only cash farm operating expenses were used as "inputs" as related to cash farm income for "output."

The stations in the Melfort district of northeastern Saskatchewan and the Manitoba stations showed the best overall efficiency during the period 1948-52, while the stations in New Brunswick and the Lacombe district of central Alberta were the lowest. While average figures are used for the purpose of this report, station farms are studied individually and production methods employed or introduced are evaluated from the standpoint of their economic effectiveness as well as volume of production.

Cost of Summerfallow and Cost of Producing Wheat on Fallow

On Illustration Stations and Substations in the Prairie Provinces cost studies of producing cereals on fallow have been conducted within the structure of the main farm business studies. The objective of these studies is not only to determine what the costs are under varying soil and climatic conditions

TABLE 18.—Comparisons of Measures of Farm Efficiency Illustration Stations and District Experiment Substations Annual Averages, Five-Year Period 1948-52.

Districts	Number of stations	Scale	Intensity			Over-all efficiency
		Capital labor and management earnings per farm	Investment per acre of cropland	Gross receipts per acre of cropland	Acres of cropland per man-equivalent	Total return per dollar of input
		$	$	$	Acres	$
Saanichton, B.C.	3	2,673	362	156	25	1.44
Agassiz, B.C.	4	2,360	254	89	41	1.87
Prince George, B.C.	5	1,849	157	40	74	1.53
Fort William, Ont.*	4	2,445	154	50	72	1.95
Mindemoya, Ont.	5	2,760	190	53	62	1.88
Ottawa, Ont.	7	2,852	206	71	56	1.46
Kapuskasing, Ont.	6	1,658	168	58	46	1.39
L'Assomption, Que.	9	2,740	181	44	55	1.77
Ste-Anne-de-la-Pocatière, Que.	7	1,814	214	97	34	1.27
Lennoxville, Que.	12	1,900	237	107	30	1.31
Normandin, Que.	5	3,221	189	70	40	1.86
Fredericton, N.B.	11	1,005	200	85	34	1.22
Kentville, N.S.	4	2,557	231	92	30	1.67
Nappan, N.S.	5	1,917	277	93	27	1.57
Charlottetown, P.E.I.	7	1,869	164	64	54	1.47
Beaverlodge, Alta.	4	1,098	59	15	149	1.31
Lethbridge, Alta.	10	6,203	31	12	871	1.69
Lacombe, Alta.	6	2,258	64	18	311	1.26
Melfort, Sask.	7	2,501	66	15	199	2.06
Scott, Sask.	6	2,638	45	11	447	1.57
Indian Head, Sask.	9	4,546	52	17	345	1.55
Swift Current, Sask.	10	3,992	34	10	677	1.60
Brandon, Man.	12	4,741	63	22	207	2.01
All Districts	.....	2,855	69	23	173	1.55

*Not a 5-year average for two stations.

but also to evaluate the importance of the factors that contribute to costs and to establish methods of production whereby such costs might be materially lessened. The importance of preparing good summerfallow is emphasized by the fact that the cost of summerfallow plus interest charges at 6 per cent per annum makes up about one third of the cost per acre of producing wheat on summerfallow. The charges considered in calculation of the costs of cereal production include this cost of summerfallow from the previous year, plus interest, use of land and buildings, taxes, seed, hail insurance, machinery use, labor, general farm expenses, and a charge for management by the farm operator.

Summerfallow costs tend to be higher in the Black and Gray Wooded soil zones than in the Brown and Dark Brown zones, on a per acre basis. However, in terms of average yields of wheat on fallow, the costs for the different soil zones are very close due to the higher yields on the Black and Gray Wooded soils. The results of studies on cost of summerfallow and average yields of wheat on fallow are summarized in Table 19 by station and soil zone.

Variations in costs between stations in each soil zone are the results of such factors as high land-use charges and taxes on high-priced land or as a result of a credit for use of cover crops as pasture which constitutes a reduction from the total cost of summerfallow. This latter situation exists at Claresholm, Alta., while at Fairview in the Peace River District, the initial cost of breaking brome grass sod raised the cost substantially.

TABLE 19.—Cost of Summerfallow and Yields of Wheat after Summerfallow on Illustration Stations and District Experiment Substations, for Specified Periods of Years

Station and soil zone	Soil type	Period	Number of years	Cost per acre of summer-fallow	Average yield per acre	Fallow cost per bushel of wheat
				$	bu.	cts.
BROWN—						
Bracken, Sask.	Echo C.L.	1942-52	11	2.80	13·7	20
Fox Valley, Sask.	Fox Valley L.	1942-52	11	2.88	13·1	22
Gravelbourg, Sask.	Sceptre C.	1942-52	11	4.89	23·4	21
Kincaid, Sask.	Fox Valley Si.C.L.	1942-52	11	3.89	20·0	19
Kindersley, Sask.	Sceptre C.	1944-52	9	4.87	15·7	31
Limerick, Sask.	Haverhill C.L.	1942-52	11	4.33	18·5	23
Lisieux, Sask.	Wood Mt. L.	1938-52	15	3.15	19·3	16
Loverna, Sask.	Fox Valley Si.C.L.	1944-52	9	3.31	11·8	28
Shackleton, Sask.	Sceptre C.	1942-52	11	4.08	16·5	25
Shaunavon, Sask.	Haverhill, C.L.	1942-52	11	3.83	16·5	23
Tugaske, Sask.	Weyburn L.	1942-52	11	4·22	21·2	20
Valjean, Sask.	Chaplin & Hatton F.S.L	1942-52	11	3.49	15·6	22
Acadia Valley, Alta.	Lacustrine C. and C.L.	1940-51	12	3.20	21·5	15
Bindloss, Alta.	Eolian Si.L.	1938-51	14	2.78	15·1	18
Foremost, Alta.	Lacustrine Si.L. & C.L.	1938-51	14	2.97	14·6	20
Lomond, Alta.	Glacial C.L.	1938-51	14	2.95	17·0	17
Whitla, Alta.	Glacial L. to Li.Si.L.	1938-51	14	2.20	9·2	24
GROUP AVERAGE			12	3.45	16·6	21
DARK BROWN—						
Boissevain, Man.	Waskada C.L.	1940-52	13	5.34	27·2	20
Goodlands, Man.	Waskada C.L.	1940-52	13	5.44	26·4	21
Lyleton, (E), Man.	Souris F.S.L.	1940-52	13	5.65	26·6	21
Lyleton, (P), Man.	Souris F.S.L.	1940-52	13	5.36	21·8	25
Pipestone, Man.	Bede Co.S.L.	1940-52	13	3.94	9·6	41
Alameda, Sask.	Estevan & Oxbow L.	1938-52	15	4.49	21·2	21
Arcola, Sask.	Cudworth Si.L. & Oxbow L.	1938-52	15	5.66	21·7	26
Aylesbury, Sask.	Elstow C.L.	1938-52	15	4.29	17·2	25
Carmichael, Sask.	Cypress & Wood Mt. C.L	1942-52	11	3.62	16·7	22
Conquest, Sask.	Asquith and Elstow L.	1946-52	7	4.35	21·1	21
Guernsey, Sask.	Asquith F.S.L.	1936-52	17	3.68	22·5	16
Radville Sask.	Trossachs C.L.	1938 52	15	4.59	26·7	17
Rosetown, Sask.	Elstow, Si.C.	1944-52	9	4.92	18·8	26

TABLE 19.—Cost of Summerfallow and Yields of Wheat After Summerfallow on Illustration Stations and District Experiment Substations, for Specified Periods of Years (Concluded)

Station and soil zone	Soil type	Period	Number of years	Cost per acre of summer-fallow	Average yield per acre	Fallow cost per bushel of wheat
				$	bu.	cts.
Strasbourg, (H), Sask.	Oxbow L.	1938-52	15	3.82	21·7	18
Strasbourg, (C), Sask.	Oxbow L.	1938-52	15	3.74	19·2	19
Castor, Alta.	Halkerk L. & Hughendon L.	1933-51	19	3.22	16·0	20
Chauvin, Alta.	Metiskow L.	1933-51	19	4.12	22·9	18
Claresholm, Alta.	Alluvial & Lacustrine F.S.L.	1938-51	14	2.19	22·8	10
Craigmyle, Alta.	Alluvial & Glacial Li.L.	1940-51	12	4.41	20·7	21
Drumheller, Alta.	Lacustrine Li.L. to H.C.	1940-51	12	3.53	33·1	11
Metiskow, Alta.	Wainwright S. & L.S.	1938-51	14	2.56	12·2	21
Nobleford, Alta.	Lacustrine H.C. to Si. L.	1940-51	12	7.48	32·5	23
GROUP AVERAGE			14	4.32	21·6	20
BLACK—						
Dugald, Man.	Red River C.	1940-52	13	6.75	31·4	21
Hargrave (JRO), Man.	Oxbow C.L.	1940-52	13	6.28	24·2	26
Hargrave (HCO), Man.	Oxbow C.L.	1940-52	13	8.65	28·8	30
Katrime, Man.	Whitemud C.	1940-52	13	7·08	30·8	23
Silverton, Man.	Newdale C.L.	1940-52	13	6.93	34·4	20
Hafford, Sask.	Oxbow L.	1935-52	18	3.64	15·8	23
Wawota, Sask.	Ryerson L.	1938-52	15	5.16	23·0	22
Yorkton, Sask.	Canora Si.L.	1938-52	15	7.51	25·0	30
Fairview, Alta.	Landry Si.L. and C.L.	1945-52	8	6.57	11·5	57
Pincher Creek, Alta.	Lacustrine C. and L.	1938-51	14	4.89	33·4	15
St. Paul, Alta.	Angus Ridge L.	1944-50	7	4.95	21·5	23
Baldonnel, B.C.	Lacustrine and Alluvial L	1945-52	8	5.87	29.1	20
GROUP AVERAGE			12	6.15	25·9	24
GRAY—						
Arborg, Man.	Arborg, H.C.L.	1940-52	13	7.75	28·9	27
Lenswood, Man.	Lenswood V.F.S.L.	1940-52	13	7.98	29·2	27
Glaslyn, Sask.	Whitewood and Waitville L.	1946-52	7	5.57	18·5	30
Glenbush, Sask.	Oxbow, Whitewood, Glenbush L.	1946-52	7	4.70	21.2	22
Paddockwood, Sask.	Pelly L.	1948-52	5	5.12	24·1	21
Parkside, Sask.	Shellbrook V.F.S.L.	1936-52	17	4.80	21·1	23
Snowden, Sask.	Waitville C. L.	1944-52	9	5.93	26·4	22
Star City, Sask.	Waitville L.	1948-52	5	7.31	26·4	28
White Fox, Sask.	Waitville Li.L. & V.S.L.	1936-52	17	5.53	31·6	18
Chedderville, Alta.	Breton L.	1941-51	11	4.18	27·9	15
Goodfare, Alta.	Donnelly H. L. & C.L.	1946-52	7	3.58	8·1	44
McLennan, Alta.	Nampa H.L. and C.L.	1947-52	6	4.54	24.2	19
GROUP AVERAGE			10	5.69	25·0	23

Key to Abbreviations:

L.—Loam, C.—Clay, H.—Heavy, S.—Sandy, Si.—Silty, Li.—Light, F.—Fine, Co.—Coarse, V.—Very.

The objective of cost studies on wheat production, as pointed out previously in this section, is not only to determine what the costs are under varying soil types, seasonal conditions, and cultural practices, but also to evaluate the relative importance of the factors that contribute to the costs and to determine, if possible, the significant levels at which costs of production may be reduced. In Table 20 it will be noted that for all stations about 70·7 per cent of the cost of growing wheat on fallow has been spent up to the end of seeding. The nature of these high fixed costs in wheat production on fallow emphasizes the importance of good tillage practices. It will also be noted that the charge to the crop for summerfallow represents a greater proportion of the total cost

of production per acre in the Brown and Dark Brown soil zones than in the other soil zones. This is due largely to the higher harvesting costs that are encountered in the Black and Gray Wooded zones. Also the cropping sequences that are employed in the different zones are reflected in the charge for fallow. A two-year cropping sequence of fallow and wheat, as employed on many stations in the Brown soil zone, results in the total charge for fallow being made against the first crop. However, in the more humid sections, a three-year cropping sequence of fallow, wheat, and wheat or coarse grains requires that only two-thirds of the cost of fallow be charged to the first crop. In terms of actual dollars, however, total costs of producing wheat per acre on fallow have been highest on the stations on the Black and Gray Wooded soils and lowest on the Brown soils during the period studied.

TABLE 20.—Distribution of the Costs Per Acre of Producing Wheat on Fallow in the Four Major Soil Zones of the Prairie Provinces

Illustration Stations and District Experiment Substations, 1951-52

Item	Soil Zone				
	Brown	Dark Brown	Black	Gray Wooded	All Zones
	%	%	%	%	%
Use of land and buildings, taxes	9·5	9·4	9·9	8·1	9·2
Cost of fallow plus interest @ 6%	32·8	33·8	28·9	25·8	30·2
Seed	14·5	16·4	14·4	14·8	15·1
Hail insurance	1·1	0·6	0·7	0·4	0·7
Machine use:					
Preparation, seeding, spraying (Including spray and fertilizer)	7·8	8·5	13·1	13·0	10·7
Combining	14·7	13·8	11·9	8·2	11·9
Binding and threshing	2·7	1·1	3·8	15·4	6·2
General equipment	4·1	4·0	2·9	1·5	3·0
Hauling	5·3	3·4	3·9	3·8	4·0
Miscellaneous man and horse labor	0·3	—	0·7	1·0	0·5
Interest on net cost @ 3%	0·9	0·9	1·1	1·4	1·1
General farm expenses	1·3	3·0	3·0	2·9	2·6
Management (5% of land value)	5·0	5·1	5·7	3·7	4·8
Total cost	100·0	100·0	100·0	100·0	100·0

FIELD DAYS

In view of the development of experimental work on each station along lines that have specific application to farm problems in the districts served, field days provide an opportunity for farmers to view results in the field under conditions similar to those encountered on their own farms. All meetings are organized in co-operation with local agricultural societies and officers of the extension services of provincial departments of agriculture. It is an established policy of the Illustration Stations Division to co-operate with other divisions of the Experimental Farms Service and other services of the Department of Agriculture in the conduct of these events. This affords an opportunity for officers of these Divisions to become familiar with the problems peculiar to each district and at the same time make a contribution to the field day program. In later years the use of motion picture equipment has permitted the bringing of information to farmers on topics of national as well as of local interest and importance. During the period 1948-53, inclusive, 798 field days were held on station farms and were attended by 79,700 farmers, or an

average of 100 per meeting. The largest attendance in any one year during this period was in 1949 when 14,280 persons attended organized field days to examine Illustration Station projects in the field. Average attendance at field days in Eastern Canada and British Columbia during this period was 105 persons as compared with 93 persons visiting Prairie stations. The stations in the Ste. Anne de la Pocatiere district of eastern Quebec received the highest number of visitors at field days, an average attendance of over 230 persons per meeting.

EXPERIMENTAL PROJECTS

Soil Fertility

Plant Food Deficiency Studies on Podzolized and Peaty Soils
Chemical Fertilizer: Study of Formulae
Chemical Fertilizer: Study of Rates
Utilization of Farm Manure
Effect of Ground Limestone on Farm Crops
Effect of Trace Elements on Crop Production
Root Fiber and Crop Residue in Soil Improvement

Cultural Methods and Practices

Control of Weeds by Cultural Methods
Control of Weeds by Chemicals
Contour Farming
Cultural Treatments for Summerfallow
Soil Moisture Studies in Relation to Crop Yields
Control of Soil Drifting.

Agricultural Engineering

Water Erosion Control
Study of Irrigation Methods

Meteorological Studies

Records of Regional Precipitation
Records of Regional Temperature

Cereals

Rate of Seeding
Date of Seeding
Testing Cereal Varieties

Forage Crops

Testing Mixtures for Hay or Pasture
Testing Varieties of Grasses and Legumes
Adaptation of Grasses and Legumes to Varying Regional Conditions

Pasture

Testing Formulae and Rates of Chemical Fertilizers for Pasture
Seeding and Management Studies
Range Land Pasture Management

Root and Silage Crops

Testing Mangel Varieties
Testing Turnip Varieties
Testing Corn Varieties for Grain and Fodder

Potatoes

Testing Potato Varieties
Crop Sequence and Cover Crops for Potato Production

Horticulture

Farm Shelterbelts
Small Fruit Variety Tests
Garden Vegetable Variety Tests

Special Crops

Testing Soybean Varieties
Testing Flax Varieties
Blueberry Production Studies
Cranberry Production Studies

Livestock

Livestock Production Studies
Livestock Pathological Records

Farm Management

Yield and Cost of Producing Farm Crops
Study of Farm Business
Farm Woodlot Management
Study of Crop Rotations

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