CANADA
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS SERVICE

DIVISION OF ILLUSTRATION STATIONS

CENTRAL EXPERIMENTAL FARM, OTTAWA

JOHN C. MOYNAN, B.S.A., CHIEF SUPERVISOR

PROGRESS REPORT 1938-1947

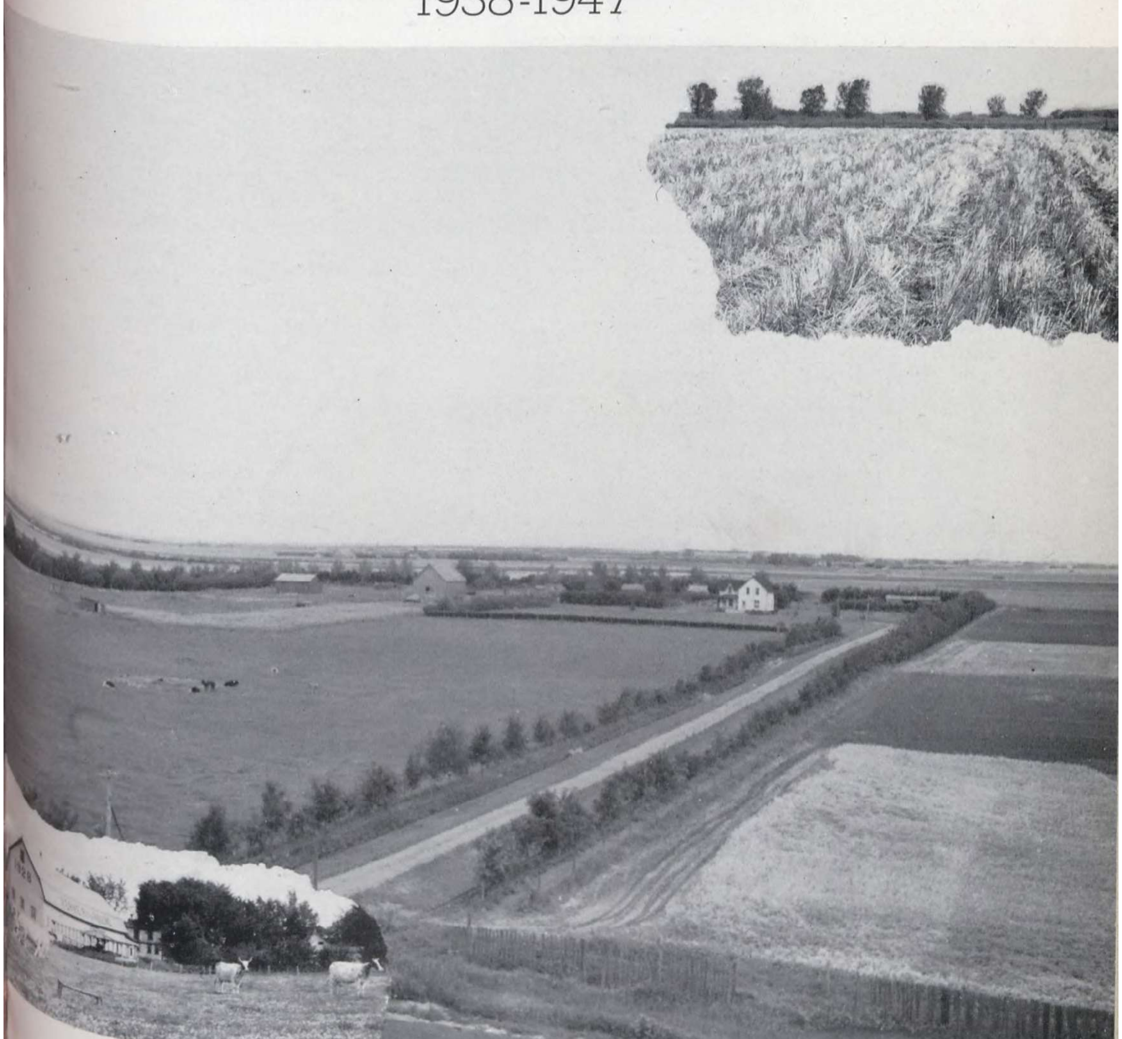


ILLUSTRATION STATIONS: EAST AND WEST
LEFT: QUEBEC—FERTILIZED PERMANENT PASTURE. CENTRE: MANITOBA — SHELTERBELTS AND STRIP FARMING. RIGHT: "TRASH COVER" ON SOUTHERN ALBERTA STATION, BLADE CULTIVATOR USED.

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

PERSONNEL

Division of Illustration Stations

CENTRAL EXPERIMENTAL FARM, OTTAWA, ONT.

J. C. Moynan, B.S.A., *Chief Supervisor*

A. E. Barrett, B.S.A. M.Sc., *Assistant Chief Supervisor*

R. Cairns, B.S.A., *Supervisor*

L. Bellefleur, B.S.A., *Supervisor*

L. M. Casserly, B.S.A., *Supervisor*

DISTRICT SUPERVISORS

Eastern Canada

W. N. Black, B.S.A.,
Charlottetown, P.E.I.

F. B. Kinsman, B.S.A.,
Kentville, N.S.

F. Calder, B.S.A.,
Nappan, N.S.

E. A. Grant, B.S.A.
*W. A. Burgess, B.S.A.,
Fredericton, N.B.

R. Caron, B.S.A.,
Ste. Anne de la Pocatière, P.Q.

O. Allard, B.S.A.,
Lennoxville, P.Q.

*G. H. Harvey, B.S.A.,
Normandin, P.Q.

C. B. Dalton, B.S.A.,
Mindemoya, Ont.

F. X. Gosselin, B.S.A.,
Kapuskasing, Ont.

J. K. Knights, B.S.A.,
Fort William, Ont

Western Canada

B. J. Gorby, B.S.A.,
*D. A. Duncan, B.S.A.,
Brandon, Man.

R. N. McIver, B.S.A.,
Indian Head, Sask.

K. E. Bowren, B.S.A.,
*A. R. Mack, B.S.A.,
Melfort, Sask.

N. A. Korven, B.S.A.,
Swift Current, Sask.

C. H. Keys, B.S.A.,
*W. B. Towill, B.S.A.,
Scott, Sask.

*A. D. Smith, B.S.A.,
Lethbridge, Alta.

*A. W. Wilton, B.S.A.,
A. R. Aitken, B.S.A.,
Lacombe, Alta.

D. J. Macdonald, B.S.A.,
Beaverlodge, Alta.

*J. R. Barry, B.S.A.,
Prince George, B.C.

F. M. Chapman, B.S.A.,
Creston, B.C.

R. M. Hall, B.S.A.,
Agassiz, B.C.

* Appointed since 1947.

CONTENTS

DIVISION OF ILLUSTRATION STATIONS

INTRODUCTION

The Illustration Stations and District Experiment Substations, totalling 208 in Canada, are linked with the centrally located Experimental Farms and Stations in a study of the agricultural problems of farmers in outlying districts. This represents an enlargement of the comprehensive work being conducted on the Experimental Farms in each province and makes it possible to study problems, resulting from variations in soil and climatic conditions, in the local environment. These 208 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, 18 Illustration Stations and District Experiment Substations in British Columbia are planned and supervized from the Experimental Farms at Agassiz and Prince George, 28 in Alberta from Lethbridge, Lacombe, and Beaverlodge, 41 in Saskatchewan from Swift Current, Scott, Melfort, and Indian Head, 17 in Manitoba from Brandon, 22 in Ontario from Kapuskasing and the Central Experimental Farm, Ottawa, 44 in Quebec from Normandin, Lennoxville, and Ste. Anne de la Pocatiere, 14 in New Brunswick from Fredericton, 14 in Nova Scotia from Kentville and Nappan, and 10 in Prince Edward Island from Charlottetown. The work carried out in each of these supervisory districts 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 ten-year period dealt with in this report, three members of the Divisional staff retired, namely: Messrs. W. L. Chauvin (deceased), R. E. Everest, and E. C. Sackville. Other Staff separations as a result of promotions to other posts in the Dominion Service, transfers to Provincial Departments of Agriculture or to commercial firms, included Messrs. D. A. Brown, R. C. Parent, G. R. Thorpe, H. A. Rogers, P. E. Cote, A. Courcy, N. F. Bell, J. D. Belzile, L. D. Fraser, H. J. Mather, N. Champagne, E. L. Eaton, and E. V. McCurdy. A great deal of the work summarized in this report results from their efforts.

This Progress Report summarizes the results of work carried out during the period from 1938 to 1947 inclusive. It also represents a continuation and expansion of projects dealt with in the 1934 to 1937 Progress Report, Part "1", on Illustration Stations in the eastern provinces of Prince Edward Island, Nova Scotia, New Brunswick, Quebec, and Ontario, also the western edition, Part "2", for the period 1934 to 1938 on Illustration Stations Division undertakings in the provinces of Manitoba, Saskatchewan, Alberta, and British Columbia.

Illustration Stations and District Experiment Substations Locations by Provinces

In the development of Illustration Stations and District Experiment Substation work the Experimental Farms Service has adopted a policy of undertaking the study of certain farm problems on privately owned farms rather than on government owned properties. By this plan it is possible for the different Experimental Farms across the Dominion to study farm production problems of a local character in their natural environment. When reviewing the work and some of the results which have been obtained over the past ten 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 farms designated as an Illustration Station or a Substation. The location of each station, with the name of the co-operating farmer who has made this working arrangement possible, is listed by provinces:—

Locations by Provinces	Co-operating Farm Owners
British Columbia—	
Alberni	Charles Chase
Armstrong	W. B. McKechnie
Armstrong	Levi Johnston
Baldonnel	H. G. Hadland
Blackpool	G. F. McGregor
Cloverdale	T. Kuhn
Courtenay	James Casanave
Fort Fraser	W. F. Clarke
Houston	Peter Ruiter
Kersley	Gordon Beath
Koksilah	B. Young
McBride	A. E. Long
Mission City	R. H. Owen
Mount Cartier, P.O.	R. Hold
Progress P.O.	Henry Bentley
Salmon Arm	James Woodburn
Vanderhoof	J. Andros
Creston	Creston Reclamation Company
Alberta—	
Black Duck Lake	Herbert Smith
Chauvin	E. A. Pitman, Jr.
Chedderville	Howard Williams
Debolt	William Perkins
Dickson	J. A. Sandberg
Fairview	K. R. Macdonald
Fallis	Mrs. E. Margerison
Goodfare	Clayton Third
Leslieville	G. N. Lynn
St. Paul	J. Rodolphe La France
Wapiti	M. E. Lofstrom
Acadia Valley	W. A. Heiden
Athabaska (Grey Wooded Soil)	Joe Eherer
Bindloss	John Barnes
Castor	C. F. Pals
Claresholm	D. L. Reynolds
Craigmyle	J. L. Branum
Dalroy	Free lease from CPR
Drumheller	L. O. and P. R. Andrews
Foremost	C. G. Wolfe
Lomond	E. M. Benson
McLennan (Grey Wooded Soil)	Emile and Narcise Lamoureux
Metiskow	E. Masson
Nobleford	C. T. Withage
Pincher Creek	E. P. Cyr
Red Deer	F. W. Chisholm H. P. Hartwick
Taber	Town of Taber
Whitla	Mrs. R. H. Babe W. N. Babe
Saskatchewan—	
Avonlea	Joseph Dombowsky
Birch Hills	J. W. Ward
Carragana	C. Banks
Glaslyn	S. Wood
Glenbush	John C. Grant
Hafford	Edward P. Hudek
North Makwa	Isaac Bowes
Paddockwood	Sidney and Stanley Martin
Parkside	Godfrey Willoughby
Star City	T. W. Jacklin and Sons

Locations by Provinces	Co-operating Farm Owners
Saskatchewan—(cont'd)	
Wawota	W. H. Pryce
White Fox	P. Tornquist
Yorkton	James Harris
Marsden	George Jones
Alameda	Gordon F. and Stanley Young
Arcola	Clarence Marsh
Aylesbury	Chas. McMillan
Bracken	James Honey
Carmichael	A. C. Butler
Conquest	Peter Kennedy
Fleming	Gordon Osborne
Fox Valley	D. Mutschler
Gravelbourg	Walter, Maurice and J. B. Pinsonneault
Guernsey	C. H. Snider
Kincaid	Wm. C. Phillips
Kindersley	Robt. Simpson
Limerick	J. W. & J. T. Smith
Lisieux	O. Prefontaine
Loon Lake (Grey Wooded Soil)	R. Kisling
Loverna	Allan Brumwell
Maple Creek	D. A. Colquhoun
Pambrum	Max Colburn
Radville	G. L. & C. L. Levee
Riverhurst	Norris C. Rudd
Rosetown	Peter Macey
Shackleton	C. D. Underwood
Shaunavon	H. Hockett
Snowden (Grey Wooded Soil)	W. D. Brown
Strasbourg	Ambrose Coles J. G. Hooper
Tugaske	Robert Wilson
Valjean	Fred Lindquist
Manitoba—	
Arborg	Victor Shebeski
Dugald	T. H. Roberts
Durban	R. C. and W. H. Harvey
Katrime	A. E. Walker
Kenville	W. A. Heselwood
Lenswood	Arthur Utting
Ste. Elizabeth	Edward P. Berard
Silverton	Joseph J. Dunn
Boissevain	C. C. Musgrove and Son
Crystal City	Hubert Edkins
Goodlands	Clinton and Stewart Bell
Hargrave	J. R. and H. C. Odell
Lyleton	J. G. Parsons G. H. Edgar
Pipestone	Harold Forder
Hudson Bay Jct., Sask.	James Leigh
Wanless, Man.	R. W. Allen

Locations by Provinces	Co-operating Farm Owners	County
Ontario—		
Appleton R. R. No. 3	Duncan W. Stewart	Lanark
Bloomfield	Holmes Matthie	Prince Edward
Caledonia Springs	Henri Gauthier	Prescott
Casselman	Hector Lafleche	Russell
Dayton	Wm. J. Boville	Algoma
Douglas	Duncan McLaren	Renfrew
Dryden	R. J. Johnston	Kenora
Earlton	Albert Rivard	Timiskaming
Emo	M. P. French	Rainy River
Fournier	L. McCulloch	Prescott
Genier	Albert Tousignant	Cochrane
Gore Bay R. R. No. 1	Cameron Clark	Manitoulin district

Locations by Provinces	Co-operating Farm Owners	County
Ontario—(cont'd)		
Kenora	George Kovall	Kenora
Lyn	H. Harris McNish and Son	Leeds
Matheson	Gerald Scratch	Cochrane
Manitowaning R. R. No. 2	D. Trimmer	Manitoulin district
Noelville	Raoul Carriere	Sudbury
Ramore	Albert Boucher	Cochrane district
Verner	Earnest Beaudry	Nipissing district
Williamstown	D. A. MacRae	Glengarry
Fort William	Campbell Hanna	Thunder Bay district
Mindemoya	Walter and Peter Williamson	Manitoulin district
Quebec—		
Amos	Leonel Cossettei	Chapleau
Amqui	Eugene Belzile	Matapedia
Batiscan	Antonio Brunelle	Champlain
Bon Desir, P.O.	Albert Simard	Saguenay
Champcoeur	Paul Beliveau	Chapleau
Clairvaux de Bagot P.O.	Donat Rivard	Bagot
Cloutier P.O.	Ovide Gauvin	Pontiac
East Broughton	Ernest Doyon	Beauce
Frampton	Laval Couture	Dorchester
Honfleur	A. Laliberte	Bellechasse
L'Acadie	Charles Deland	St. Johns
Lachecrotiere	Rosaire Mayrand	Portneuf
La Montee	Pierre Degarie	Gaspe
La Patrie	Louis Langlois	Compton
Launay	Adolphe Lord	Chapleau
Laverlochere	Alberic Trudel	Pontiac
L'Islet Station	J. C. Lemieux	L'Islet
Luceville	Philippe Bouchard	Rimouski
Maskinonge	Antonio Caron	Maskinonge
Mont Rolland	Paul Latour	Terrebonne
Notre Dame du Lac	George Plourde	Temiscouata
Peribonca	Joseph Savard	Lac St. Jean
Pintendre P.O.	Alphonse Couture	Levis
Riviere du Loup	Alcide Nadeau	Temiscouata
St. Ambroise de Chicoutimi	Ephrem Pedneault	Chicoutimi
Ste. Anne des Monts	Bertrand Deschenc	Gaspe
St. Flavien	Albert Laroche	Lotbiniere
St. Constant	Roch Boule	Laprairie
St. Etienne des Gres	Roger Bournival	Three Rivers
St. Gedeon	Joseph Simard	Lake St. John
St. Gregoire	Joseph Bouvet	Nicolet
St. Jacques	Paul Marsolais	Montcalm
St. Neree	Lazare Asselin	Bellechasse
St. Paul de Montminy	H. Gaudreau	Montmagny
St. Pierre d'Orleans	Adelard Rousseau	Montmorency
St. Prosper de Dorchester	Eugene Larochelle	Dorchester
St. Sebastien	Edouard Lachance	Frontenac
St. Urbain	Victor Fortin, Jr.	Charlevoix
St. Vallier	Albert Aube	Bellechasse
Thetford Mines	Emile Couture	Megantic
Wotton	Napoleon Corbeil	Wolfe
Makamik	Remi Auger	Chapleau
New Brunswick—		
Black River Bridge R.R. No. 2	Walter Cameron	Northumberland
Crockett	Claude Levasseur	Madawaska
Cumberland Point	Mrs. W. C. McQuinn	Queens
East Centreville	Ernest Emery	Carleton
Guercheville	Martial Dube	Restigouche
Lower Derby	W. R. Taylor	Northumberland
Mont Carmel	Cloris Melanson	Kent
St. Charles	Antoine J. Daigle	Kent
St. Isidore	Peter Robichaud	Gloucester
St. John R. R. Stn	A. B. Shillington	St. John
Salisbury	Truman Lewis	Westmorland

Locations by Provinces	Co-operating Farm Owners	County
New Brunswick—Cont'd		
Siegas	Romeo Ruest	Madawaska
Stanley R. R. No. 7	Howard Sandwith	York
Welsford	T. C. McCullum	Queens
Nova Scotia—		
Aylesford	C. S. Bezanson M. P. Nichols C. E. Smith	Kings
Centreville R. R. No. 3	Gordon Steele	Kings
Glenora Falls	Allan Beaton	Inverness
Knoydart	D. M. McDonald	Antigonish
Lunenburg	W. I. Falkenham	Lunenburg
Mavillette	J. R. Deveau	Digby
Middle Manchester	Bruce Lipsett	Guysborough
North East Margaree	T. E. Ross	Inverness
Newport	Ralph H. Zwicker	Hants
Noel Shore	J. L. Main	Hants
Sydney River	Melvin Moreshead	S. Cape Breton
West River Stn. R. R. No. 1	Fred Setchell	Pictou
New Glasgow R. R. No. 2	E. V. Paine	Pictou
Yarmouth	Douglas Knight	Yarmouth
Stewiacke	G. E. Campbell	Colchester
Prince Edward Island—		
Alliston	T. A. Hicken	Kings
Armadale	Hugh J. MacDonald	Kings
Breadalbane	John W. MacKenzie	Queens
Iona	J. E. Daly	Queens
New London	Wm. Johnstone	Queens
O'Leary	Robert Woodside	Prince
Richmond	Thos. Noonan	Prince
Rustico	J. L. Clark	Queens
Urbinville	Zenon Gallant	Prince

The great variation in climatic conditions in the districts served by Illustration Station and District Experiment Substation farms is indicated by the meteorological records. In British Columbia the precipitation during the crop season has varied from 57·01 inches at Alberni to 10·69 inches at Osoyoos. Other stations in the southern and central interior of British Columbia record precipitation ranging from 14·04 inches at Lumby to 40·87 inches as a 14-year average at Revelstoke.

In the Prairie Provinces where records on station farms such as at Whitla in Alberta show a 25-year average annual precipitation of 12·54 inches, the importance of projects dealing with moisture conservation and soil drift control is immediately apparent. The highest average annual precipitation recorded on the substations in southern Alberta has been 20·24 inches, through 25 years at Pincher Creek in the foothills region, with the lowest at Bindloss, with 10·22 inches recorded as an average of 23 years. Further north in the Peace River District average annual precipitation has ranged from a low of 14·68 inches at the Illustration Station at Progress to a high of 22·06 inches recorded at the Beaverlodge Experimental Station. In Saskatchewan the only station farms recording over 16 inches of rainfall in the calendar year, through periods of from six to seventeen years, have been Alameda and Wawota in the southeast, Snowden in the northeast and North Makwa in the northwest. In the southwest portion of the province 12-year average figures on thirteen station farms show that in no instance has average annual precipitation exceeded 15·50 inches, although variations in annual rainfall have given records greater and less than this amount in individual years. In Manitoba the general precipitation picture based on station records is somewhat more favourable. Average figures for the 12-year period 1936 to 1947 inclusive at sixteen points in the Province including Brandon Experimental Farm and Melita Reclamation Station show no instances where annual precipitation was less than 15·92 inches. The lowest figure in the southwestern part of the province, which normally is the driest, was 17·03 inches at Pipestone. In the main, the precipitation picture in Manitoba has been quite satisfactory during the period covered by this report.

In Ontario, Quebec and the Maritime Provinces, deficiency or excess of rainfall is not usually a problem although in certain years extreme conditions either wet or dry can have a marked effect on crop production. At Fort William annual precipitation at the substation has averaged 28·66 inches through eight years. In only very rare instances in these provinces has annual precipitation been less than 30 inches on Illustration Station or Substation farms where data are being collected. In the Eastern Provinces problems pertaining to land drainage, erosion control, maintenance of organic matter and plant food deficiency studies are projects which contrast sharply with work being conducted in the more arid areas of the Dominion.

FARM PLANNING AND ORGANIZATION

The standard procedure followed in the organization of an Illustration Station farm 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 Divisional work in 1915 the variety of conditions encountered has resulted in the undertaking of studies to determine the adaptability of twenty-two rotations with varying crop sequences in Eastern Canada and British Columbia. In the three Prairie Provinces twenty-nine types of grain-growing and mixed-farming rotations are under study to determine the crop sequences best adapted to the conditions of the district where these various 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 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 eight-year cropping cycles in the more northerly mixed farming areas. The rotations studied in Eastern Canada and British Columbia are discussed separately from those on the stations in the Prairie Provinces in order that the inherent differences in conditions and procedures may be appraised.

Crop Rotations under Study in Eastern Canada and British Columbia

In the mixed farming districts of Eastern Canada and British Columbia the tillable area per farm is not extensive. This necessitates careful planning of each unit in order that a high level of balanced production may be achieved. The farm plan must be designed with due consideration to the numbers and type of livestock fed. On a straight dairy unit the cropping cycle must provide the necessary pasturage and forage crops for the herd. These forage crops improve the soil by adding to it both nitrogen and organic matter. They reduce soil erosion losses where that is a problem. On farms where hog feeding is extensive the rotation should provide plenty of coarse grain. 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. Farm planning may become complicated, but it is particularly important on farms where desirable crops are found not to be adapted to all soil conditions on the property. In such cases the rotations must be so arranged that crops are grown on areas best suited to them. Often it is necessary to organize a farm so that high tonnage crops such as roots and ensilage corn may be grown near the farm buildings.

The provision of pasture in the vicinity of available water on livestock farms must be given due consideration. The increasing use of power equipment requires that the field arrangement provide for ease and economy in operation.

In the following discussion of rotations it may be explained that while the term "Hoed Crop" specifically refers to intertilled crops such as corn, roots, potatoes, etc., it is sometimes broadened to include such special crops as flax and soybeans. It is necessary to include these crops where the field acreage is greater than that required for the production of intertilled crops alone.

THREE-YEAR ROTATIONS

There are two types of mixed farming three year rotations under study on eastern Illustration stations:

1. IS-EI.31 Hoed crops—cereal (seeded)—clover hay.
2. IS-EI.32 Cereal (seeded)—clover hay—timothy hay.

Rotation "No. 2" in which the sequence is cereals seeded, clover hay, timothy hay, is established on one northerly station where the forage crops did not originally persist for long periods, where the land is infertile and the greatest possible benefit from a legume is desired as a means of increasing fertility and organic matter. However, the hoed crop—cereal (seeded)—clover cropping plan is much more widely used. The latter has been established, often as a second farm rotation, on stations where cash crops such as potatoes, table turnips and canning crops are important, and where the area of land suited to them is limited. This cropping arrangement has been established on seventeen Illustration Station farms, namely: Makamik, Batiscan, St. Vallier, L'Islet, St. Arsene, Notre Dame du Lac, Ste. Anne des Monts, New Carlisle, St. Pierre I.O., Sayabec, Grandes Bergeronnes, St. Ambroise, St. Gedeon, and St. Hilarion in Quebec; and East Centreville, Mont Carmel, and St. Charles in New Brunswick. The normal sequence followed is first year potatoes, turnips or canning crops; second year, oats seeded with 8 pounds red clover followed by one year in hay. The clover aftermath is ploughed down as a source of organic matter for the succeeding crop. Twelve tons of manure, if available, and from 600 to 1,500 pounds of chemical fertilizers are usually applied prior to planting the hoed crop. In some instances it has been found advisable to apply the manure on the clover aftermath prior to ploughing in the fall. This practice is important for crops such as potatoes in that decomposition of the manure is fairly well advanced prior to planting the tubers. During the ten-year period under study 84 crops of turnips grown in this rotation averaged 15·47 tons per acre, 104 crops of potatoes 228·5 bushels, 100 crops of oats 39·5 bushels, and 114 crops of clover hay 1·33 tons. It will be observed that the residual effect of manure and fertilizers has not been marked, in that first year hay yields have been uniformly low. This short-term rotation has a tendency to be destructive of organic matter. Potatoes, turnips, mangels, and canning corn are usually better adapted to light but early soils, which by their nature are low in organic constituents, hence, adequate amounts of manure and chemical fertilizer must be applied to maintain productivity. Where this rotation is established on heavier soil such as that on the Illustration Station at Batiscan in Quebec, a seven-year average yield of 1·96 tons of hay has been recorded. The soil in this case is a clay loam high in inherent productivity. Conversely, at St. Charles in New Brunswick, where the soil is a light sand, hay yields have dropped to as low as 0·17 tons per acre.

FOUR-YEAR ROTATIONS

Four-year rotations have been established and studied on thirty eastern Illustration Stations. There are five variations of this rotation, each being adjusted to meet certain specific conditions. They are as follows:

1. IS-EI.41 Cereal—cereal (seeded)—clover hay—timothy hay or pasture.
2. IS-EI.42 Hoed crop—cereal (seeded) —clover hay—timothy hay.
3. IS-EI.43 Cereal (seeded)—clover hay—timothy hay—timothy hay.
4. IS-EI.44 Hoed Crop—hoed crop—cereal (seeded)—clover hay.
5. IS-EI.45 Tobacco—tobacco—cereal (seeded)—clover hay.

These four-year rotations are general on the stations of western Quebec and are also under study on units throughout central and eastern sections of that province where permanent pasture land gives sustained production through the greater part of the growing season, with little or no grazing being required on the rotation fields. The most common sequence followed is: hoed crop consisting of corn, turnips and potatoes; cereals seeded to clovers and grass; clover hay; timothy hay. Rotations of four-year duration are under study at:—Cloverdale, B.C., Earlton and Manitowaning, Ontario; Launay, Maskinonge, East Broughton, Frampton, La Patrie, Pintendre, St. Flavien, St. Gregoire, St. Prosper, St. Sebastien, Thetford Mines, Wotton, St. Vallier, Cap d'Espoir, L'Islet, Luceville, New Carlisle, Nouvelle, Sayabec, Ste. Anne des Monts, St. Paul and St. Pierre d'Orleans, in Quebec. In recent years, on a number of station farms, the seeding of an area to ladiño clover and timothy has provided additional aftermath that can be grazed when seasonal conditions cause a reduction in the productivity of rough land pastures. Yields of 59 crops of ensilage corn, grown largely on eastern Quebec stations have averaged 10·11 tons per acre. Other average crop yields have been turnips, 17·56 tons from 125 crops, potatoes, 186·5 bushels from 85 crops, oats, 37·1 bushels per acre from 146 crops, first year hay 1·58 tons and second year hay 1·46 tons from 147 and 140 crops respectively. Farm manure and chemical fertilizers are applied usually in the first year of the rotation.

FIG. 1.—Cattle on Permanent Pasture at St. Vallier, Que. In background, crop of ensilage corn growing in four-year rotation, IS-EI.42. 10-year average yield 12·80 tons per acre.

The cycle listed under IS-EI.42, which includes two cereals and two hay crops, meets the needs of farmers in areas where a high proportion of cereals is required and where root, corn, and potato production is not desired either because of labour, or difficulties resulting from the soil not being suitable for the production of such crops. It is established on the stations at Batiscan, Lachevrotiere, Maskinonge and Grandes Bergeronnes in Quebec. The cereal (seeded)—clover—timothy—timothy rotation IS-EI.43 is used on the Earlton station in northern Ontario. Here the soil is a heavy clay well suited to the production of hay. The seeding mixture used is made up of timothy eight pounds, altaswede red clover five pounds, Ontario Variegated alfalfa five pounds, and alsike two pounds per acre. Satisfactory catches have been obtained here from the seeding of grasses and legumes after sod. The three successive hay crops assist in the control of perennial weeds such as Canada thistle. Manure is applied as a top dressing to the new seeding or after the removal of the first year hay crop. The rotations studied under project IS-EI.44 are designed for farms where the area of land suited to special crops is limited in proportion to the tillable area. This cropping plan was laid down at St. Zenon and Makamik, Quebec. In the burley tobacco growing areas of Quebec, two successive crops of tobacco in a four-crop cycle as listed under IS-EI.45 have proved economical at the St. Jacques station in Montcalm county.

FIVE-YEAR ROTATIONS

A five-year cropping sequence is working out satisfactorily on stations where the greater proportion of the farm land is tillable and where only a small proportion is in rough land and permanent pasture. This typical dairy farm rotation provides for pasturage within the organized rotation. There are five variations in the five-year cropping sequences under study, namely:

1. IS-EI.51 Hoed crop—cereal (seeded)—clover hay—timothy hay—timothy hay.
2. IS-EI.52 Hoed crop—cereal (seeded)—clover hay—timothy hay—cereal.
3. IS-EI.53 Cereal—cereal (seeded)—clover hay—timothy hay—timothy hay.
4. IS-EI.54 Cereal (seeded)—clover—cereal (seeded)—clover hay—timothy hay.
5. IS-EI.55 Hoed crop—flax—cereal (seeded)—clover hay—timothy hay.

The most widely used five-year rotation is IS-EI.52, in which one-fifth of the area is in hoed crop, one-fifth in coarse grains seeded down, two-fifths in hay, and one-fifth in pasture. This system has been laid down on the stations at Noelville, Thessalon, Verner, Caledonia Springs, Casselman, and Williamstown in Ontario; Lachevrotiere, St. Constant, St. Jacques, St. Simon, Honfleur, and St. Neree in Quebec; Salt Springs, Knoydart, Middle Manchester, Sydney River, N. E. Margaree, and Glenora Falls in Nova Scotia; and at Alliston, Rose Valley, and Rustico on Prince Edward Island.

The two accompanying diagrams indicate how the plan is being worked out on the station at St. Constant, Quebec. In the diagram to the left will be noted the original layout and the location of the farm fences when the work was started. On the right is the reorganized layout in the process of development. This farm at St. Constant is located close to the city of Montreal, and has been developed as a dairy enterprise. A herd of 24 milch cows contributes 76·3 per cent of the total farm revenue. In the original layout (Fig. 2), it will be observed that the farm was divided into a number of small fields of different sizes, some of which were not suited to cultivation with tractor power. Under these conditions, it was found difficult to obtain an equitable distribution of the area under different crops. When the farm became an Illustration Station, it was surveyed and reorganized into five fields, almost equal in producing capacity, to provide for a five-year system of cropping.

Hoed crop, first year:

These crops are seeded on fall ploughed land, part of which is manured in the winter or early spring. Six acres of Algonquin corn are planted on the manured section at thirty pounds an acre. On the remaining portion, Stormont Cirrus fibre flax is seeded at eighty-four pounds per acre. This flax area is manured after the crop is harvested in the fall. Both the corn and flax land receive a supplemental dressing of 500 pounds 2-12-6 chemical fertilizer broadcast previous to seeding in the spring.

Grain seeded, second year:

Vanguard and Roxton oats are seeded at the rate of 2½ bushels per acre with the following grass and clover seed mixture: timothy eight pounds, red clover five pounds, alsike clover two pounds, alfalfa three pounds, at the rate of 18 pounds per acre. This crop receives no fertilizer treatment.

Clover hay, third year:

A hay crop is harvested. Part of the field is cut early, around June 20, in order to allow the second crop time to mature seed. If conditions are favourable, a clover seed crop is obtained from the second growth,—if not, it is cut as hay or part of the area may be fall grazed as supplementary pasture.

Mixed hay, fourth year:

A hay crop is harvested, or if conditions are favourable a timothy seed crop is obtained from a portion of the field.

Pasture, fifth year:

The meadow is pastured in the fifth year of the cropping cycle, then ploughed in the fall preparatory to repeating this cropping cycle.

At the St. Constant station an additional ten-acre field adjacent to field "A" has been set aside as a permanent alfalfa area which is only ploughed and reseeded when the condition of the stand renders this undertaking necessary. Near the farm buildings an eight acre area has been reserved for permanent pasture. This field is divided by a brook which provides water for the dairy herd during the summer, and must be kept in permanent grass to prevent erosion on the steep slopes along the edge of the stream. To sustain pasture production, the area is treated with 600 pounds of chemical fertilizer of a 2-12-6 formlua, at three-year intervals. Adjacent to the home, areas "1" and "2" are in fruit and vegetable production respectively. Area number '3", at the other end of the farm is a one-acre woodlot which under careful management provides a limited quantity of lumber and fuel.

The operator of this station has found that the establishment of a planned rotation has made the farm a better managed unit; favoured the economical use of power equipment; given balanced production of cereals, forage, and cash crops; and provided a basis for the equitable distribution of manure and fertilizer, thus raising the carrying capacity of the entire farm. The fact that production is sustained in this rotation is borne out by the yields harvested from the twenty-one stations where it is under study. There has been an average yield of 13·9 tons of ensilage corn per acre on the basis of 150 crops harvested; 22·7 tons of swedes per acre on the basis of 324 crops; 43·0 bushels of oats based on 392 crops; 2·03 and 1·82 tons of cured first and second year hay respectively on 427 crops harvested.

The second variation shown above of the five-year crop rotation, which is hoed crop-cereal (seeded)—clover hay—timothy hay—cereal, has just been adjusted for an increased acreage of cereal crops by growing them the year previous to, and after, the hoed crop. It is established on the stations at Alberni, Courtenay and Revelstoke in British Columbia; and at Noel Shore, Newport, Lilydale, Mavillette and Cheggogin in Nova Scotia. The third listed alternative five-year cycle of cereal, cereal seeded, clover hay, timothy, and timothy hay is adapted to areas where roots and corn are not generally grown, and where a high proportion of coarse grain is needed. This rotation is under study at Makamik, Champcoeur, Laverlochere, Palmarol and Senneterre in Quebec; and

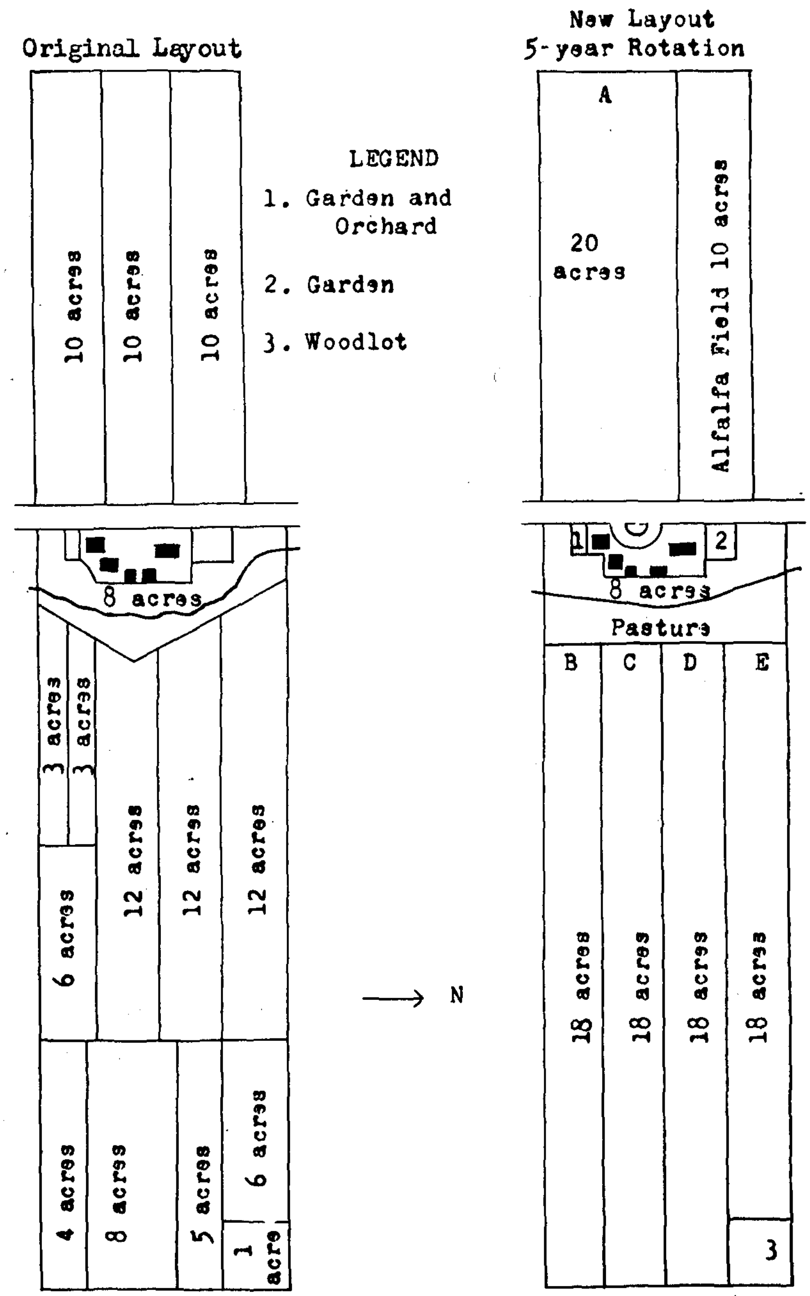


FIG. 2.—St. Constant Illustration Station.

Moonbeam, Ramore, Manitowaning, and Gore Bay in Ontario. The cropping system listed under "No. 4", IS-EI. 54, in which the grasses and clovers are seeded twice in the five-year period, is adapted to areas where the soil is unproductive and low in organic matter, the purpose being to make as much use of a legume crop as possible. The fifth variation given above of the five-year rotation, which includes a year of flax production, is designed for districts such as L'Acadie, where fibre flax growing has been a major enterprise. In the five-year rotations which do not include hoed crops, manure is applied in the fall as a top dressing on new seeding or the following spring to the clover crops.

SIX; EIGHT; AND TEN-YEAR ROTATIONS

Long-term rotations have been developed in areas where soil and climatic conditions are such that alfalfa or other hay crops persist in a productive state beyond the third year. The general practice in these areas is to divide the farm into six, eight, or ten fields comparatively equal in area. Each year one of these is devoted to hoed crop, one or two to cereals, and the remainder to hay and pasture production. The proportionate number of fields allotted to each crop is modified to meet the soil and climatic conditions existing on each unit.

Some of the longer rotations of six-, eight-, and ten-years duration being followed on stations in mixed-farming districts are listed below:

IS-EI.62: Six-year rotation

1st year—hoed crop	4th year—timothy hay
2nd year—cereal seeded	5th year—timothy hay
3rd year—clover hay	6th year—cereal

This cropping system has proved well adapted to the conditions at Bloomfield in Ontario and at Iona, Monticello, New London, and Richmond in Prince Edward Island. It has provided a fair balance of succulent feeds such as corn and roots as well as hay, and grain for the maintenance of the herds. At Bloomfield it serves as both a feed crop and canning crop rotation. On this farm, located in an area where tomatoes are grown for commercial processing, the choice of satisfactory soil areas for tomato production is a problem due to numerous outcroppings of shallow soils or drought spots. The six-year cropping sequence followed allows choice of either the hoed crop field or the cereal field following timothy hay for tomato production. Flexibility in the choice of areas is particularly important for special crops which have specific soil requirements.

IS-EI.64: Six-year rotation

1st year—hoed crop	4th year—mixed hay
2nd year—cereals seeded	5th year—mixed hay
3rd year—clover hay	6th year—mixed hay

This six-year cropping plan is adapted to soils which favour the production of alfalfa. When this system is well organized it has provided an abundance of forage crops resulting from seed mixtures made up of five pounds alfalfa, five pounds early red clover, two pounds alsike and eight pounds of timothy per acre. This cropping plan has been laid down on the stations at Verner, Mindemoya and Appleton in Ontario, and at Montbeillard in Quebec. At Verner the eighteen year average yields recorded in this rotation have been silage corn 18·18 tons; oats, 49·3 bushels; clover hay, 2·60 tons, and mixed hay, 2·19 tons per acre.

IS-EI.65: Six-year rotation

1st year—hoed crop	4th year—cereals seeded
2nd year—cereals seeded	5th year—clover hay
3rd year—clover hay	6th year—timothy hay

This rotation has been established on stations which lend themselves to a six-field division, although hay crops do not remain productive beyond the second year. In former years this cropping system was instituted on Illustration Stations in British Columbia where clover seed production was under study. In view of the fact that two fields were in first-year hay the area available for seed production was considerably greater. This rotation also provides a relatively high proportion of cereal crops. It is active at the present time on the stations at Emo and Dryden in Ontario, and St. Etienne des Gres in Quebec.

IS-EI.66: Six-year rotation

1st year—partial fallow (seeded)	4th year—mixed hay
2nd year—mixed hay	5th year—cereal
3rd year—mixed hay	6th year—cereal

This cropping cycle has been adapted to those stations where moisture conditions are such that it is unsafe to seed the forage crop with a nurse crop. It is under study at Quesnel, McBride, Vanderhoof and Fort Fraser in central British Columbia.

IS-EI.81: Eight-year rotation

1st year—hoed crop	5th year—alfalfa hay
2nd year—cereal seeded	6th year—alfalfa hay
3rd year—alfalfa hay	7th year—cereal
4th year—alfalfa hay	8th year—cereal

This long-term rotation is designed for farms on which alfalfa thrives and livestock production is a main enterprise. It is laid down and under study at Australian, Duncan, Lumby, and Salmon Arm station farms in British Columbia.

IS-EI.82: Eight-year rotation

1st year—hoed crop
2nd year—cereal seeded
3rd to 6th years—alfalfa hay
7th and 8th years—pasture

This rotation has been tried out at the Fort William station in Ontario. Over a period of years it has been found that alfalfa does not persist through six years of hay and pasture, hence in the future the cropping arrangement will be shortened to centre around such crops as potatoes, cereals, red clover, alsike and ladino clover, in a four year crop system.

IS-EI.101: Ten-year rotation

1st year—hoed crop
2nd to 8th years—alfalfa
9th and 10th years—cereals

This ten-year rotation has been conducted with success on the Armstrong station in British Columbia. Under the excellent conditions obtaining on this farm there has been little reduction in yield in normal years on the older alfalfa meadows. Through twelve years an average yield of 1·89 tons per acre has been recorded on the sixth year alfalfa meadow.

Two Rotations are Often Advisable for Most Efficient Land Use

With the widely varying conditions and soil types on Eastern Canadian and British Columbia farms, it is obvious that a single rotation may not be suitable on all stations. A certain proportion of any one farm unit may be especially adapted to specific crops, while another area may be quite unsuitable for those crops. Another factor necessitating double rotations is the shape of many farms, which makes it uneconomical to grow silage crops at a great distance from the silo. These factors, and others, have led to the establishment of dual rotations on many units. On these stations the main farm rotation is usually modified to the production of grain and hay, while a shorter three- or four-year rotation is established for the production of corn, potatoes, swedes, and special crops on areas especially suited to them, or convenient to the farm buildings. An example of this is shown in Figure 3. On this farm at Manitowaning in the Manitoulin district of Ontario the fields lettered "A","B", "C", "D", and "E" are cropped in a five-year rotation. The crops seeded and the methods followed in land preparation and fertilization in this rotation are as follows:

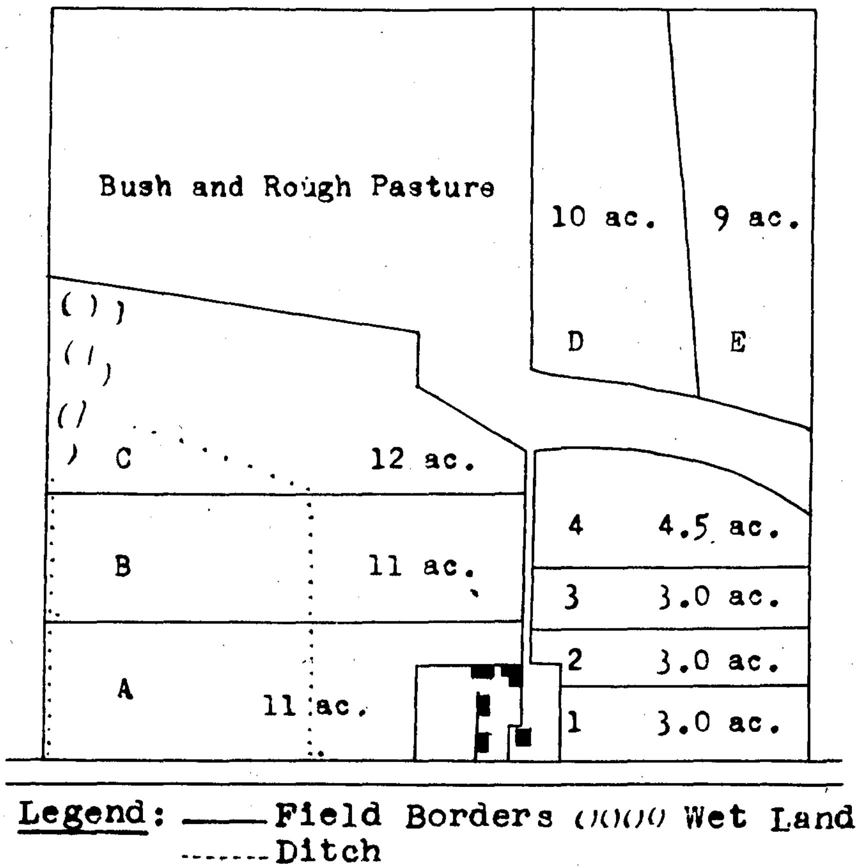


FIG. 3.—Field Plan: Manitowaning Illustration Station.

1st year—Cereals: Beaver oats are seeded at 2½ bushels per acre on 80 per cent of the field area. The remainder of the field is seeded to Montcalm barley at 2 bushels per acre. These grain crops are not seeded down to grasses and clovers.

2nd year—Cereals seeded down: Beaver oats are seeded at 2½ bushels per acre and seeded down with 16 pounds per acre of a mixture compounded in the proportions of 8 pounds of timothy, 5 pounds alfalfa, 5 pounds red clover and 2 pounds of alsike clover. The new seeding is top dressed after the oat crop is removed in the fall with eight tons per acre of farm manure.

3rd year—Clover hay.

4th year—Mixed hay.

5th year—Mixed hay. Following removal of the hay crop in the fifth year the land is fall ploughed in preparation for the cereal crop the following year and a renewal of the sequence.

In this rotation weed control measures can take the form of herbicidal sprays on the cereal crop which is not seeded down in the first year, after-harvest cultivation on first year oat stubble or early ploughing and tillage of the third-year hay meadow, after the crop is removed in the fifth year of the rotation.

On the smaller fields numbered 1, 2, 3, and 4, which are particularly well suited to roots and potatoes, a four-year rotation of hoed crops, grain seeded, hay, hay, is followed.

The seeding and cultural methods followed in this four-year rotation are:

1st year—Potatoes: Irish Cobblers are usually grown to meet early market requirements.

Swedes: The Laurentian variety is grown in view of its suitability for the table turnips trade. The surplus crop is used for feed.

2nd year—Grain and seeded: This field is either (1) seeded to Beaver oats and seeded down with the mixture outlined under the five-year rotation, except that the rate of seeding is 20 pounds per acre, or (2) seeded to fall wheat. When sown to fall wheat the field is summer cultivated and seeded in August to either Rideau or Cornell 595 varieties at the rate of 1½ to 2 bushels per acre. The timothy in the grass and clover mixture is seeded at this time at the rate of 8 pounds per acre. Early the following spring the alfalfa, red clover and alsike clover are sown broadcast with a cyclone seeder at the rate of 5, 5, and 2 pounds per acre respectively. Good stands of grass and clover have been obtained with this method of seeding.

3rd year—Single cut of mixed hay.

4th year—Single cut of mixed hay: Following removal of the hay crop the field is ploughed shallow about the end of July and receives sufficient tillage to prevent any growth of grass or weeds. The land is manured in the fall at the rate of 10 tons per acre and ploughed to a depth of six inches in preparation for hoed crops the following year.

In contrast to the practice followed with the five-year rotation, weed control in this four-year rotation is accomplished entirely by tillage. Selective weed sprays cannot be used on the grain field in view of their harmful effect on clovers. The yields per acre recorded in this rotation have been potatoes, 252·7 bushels; fall wheat, 23·4 bushels; oats, 72·0 bushels; first year hay, 2·10 tons.

The practice of having the farm divided for two or more rotations is widespread, and has greatly assisted in increasing yields by providing areas suited to those crops more sensitive to environmental factors. This practice is particularly valuable on the long narrow farms of Quebec where it is uneconomical to haul root and corn crops from the extreme end of the farms. It is also valuable in those areas where cash crops such as potatoes, tobacco, swedes, etc., are grown as a supplement to the general farm business.

Crop Adaptation

Continuous records maintained on these rotational projects give important information on the regional adaptation of the different crops. From the standpoint of hay production, British Columbia stations recorded a yield of 2·49 tons per acre of first-year hay as an average of 178 crops harvested. This yield was only surpassed by station farms in Nova Scotia which recorded an average yield of 2·63 tons per acre from 150 crops. Per-acre yields of first-year hay recorded in Ontario and Quebec are 1·68 tons from 214 crops and 1·36 tons from 360 crops respectively. In Ontario the most productive area for hay crops where stations are located, has been eastern and central Ontario, with an average yield of 2·19 tons. Preliminary studies of these data indicate that a positive relationship may exist between yields of other crops such as cereals and an effective forage crop program, in that average yields of oats recorded per acre were 61·0 bushels from 177 crops in British Columbia; 39·5 bushels for 206 crops in Ontario; 32·3 bushels for 326 crops in Quebec, and 50·2 bushels for 120 crops in Nova Scotia.

Certain crops such as corn with definite climatic requirements have reacted sharply to any extension of their normal zones. In British Columbia, 46 crops of silage corn recorded an average yield of 12·68 tons per acre. These were grown almost solely on the more southerly stations at Courtenay, Alberni, and Armstrong. In Ontario, silage corn has been grown as far north as Earlton in Timiskaming District but at that point yielded only 8·80 tons in comparison to an average of 14·47 tons in eastern and central Ontario and 14·34 tons in western Quebec. Yields of silage corn tend to decrease in the areas north and east of eastern and central Ontario and western Quebec to 9·53 tons in the Manitoulin and Nipissing District, 11·46 tons in central Quebec, 11·38 tons in Lake St. John, and 9·95 tons in eastern Quebec. In Prince Edward Island, and average yield of 12·10 tons per acre was recorded on 25 crops of silage corn during the period under study.

Crop Rotations Under Study in the Prairie Provinces

During the period 1938 to 1947 inclusive, twenty-nine crop rotations or sequences of from two to eight years in duration, have been under study on Illustration Station and District Experiment Substation farms in the three Prairie Provinces. This relatively large number of crop sequence arrangements has been developed as a result of the variety of soil and climatic conditions peculiar to the districts served by the 130 station farms throughout the area. The most important factors governing the selection of a crop rotation on the prairies are soil conservation, moisture conservation, weed control and the type of farming in the district concerned. These factors are very closely related to and in most cases are governed by the soil zones, and it would seem most advisable to review the crop rotations as they are practised in the zones to which they are adapted. The major soil zones of the Prairie Provinces are the brown, the dark brown, the black and the grey wooded. Minor variations occur within each of these major soil zones and are largely responsible for the great diversity in crop sequence practices.

THE BROWN SOIL ZONE

Experiments on crop rotations and soil moisture studies conducted on the substations in the brown soil zone have shown that soil moisture is the chief limiting factor in crop production. Because of this, the most common practice is to use a two-year rotation of fallow-grain. Seeding on stubble land has been found unsatisfactory except in rare years when there is a good supply of reserve moisture in the soil, or when seasonal rainfall has been considerably above average. On the substation farms at Bracken, Fox Valley, Gravelbourg, Kincaid, Kindersley, Limerick, Loverna, Riverhurst, Shaunavon, Tompkins, Valjean and Shackleton in Saskatchewan, and at Acadia Valley, Bindloss, Foremost and Whitla in Alberta the average yield of 236 crops of wheat in a two-year rotation of fallow-wheat was 15·4 bushels per acre. With the exception of the stations at Gravelbourg, Shaunavon, Shackleton and Tompkins, three-year rotations of fallow-wheat—wheat were conducted through periods ranging from one to ten years, for the purpose of comparison. The average yield of first-year wheat on fallow from 84 crops in this rotation was 15·6 bushels and that of second crop wheat on stubble 8·6 bushels per acre. On the average this represented from the second crop wheat a reduction in yield of 44·9 per cent. In the more arid areas the reduction in yield on the second crop is greater than the average figures quoted above. On the substation at Whitla in southeastern Alberta ten crops of wheat on fallow in this three-year rotation averaged 8·9 bushels per acre in comparison with an average yield of 1·5 bushels per acre from ten crops on stubble in identical years. The lighter sandy soils of this zone cannot be summerfallowed to advantage in view of their low moisture holding capacity and susceptibility to drifting. Results of studies on Asquith fine sandy loam on the substation at Conquest, Saskatchewan, have shown that the most satisfactory practice has been to follow a continuous cropping system.

Rotations which include grasses and legumes in a systematic order have been tested but have been found unsuitable in this subhumid climate soil zone. Considerable difficulty has been experienced in obtaining "stands" and results to date indicate that, after breaking, land which has been under grass is as subject to wind erosion as land which has been cropped in the regular manner. Yields of summerfallow breaking have been lower than those on standard fallow. While grass or legume crops have not been found to be advisable in main farm rotations in this zone they can be used to advantage for hay or pasture as a more or less permanent crop.

It is generally believed by growers that wheat is better adapted to this soil zone than other grain crops. Results on substations in southwestern Saskatchewan show that barley and oats sown early on fallow have frequently produced more pounds of grain per acre than wheat. Flax is a more uncertain crop because of its inability to compete with weeds, especially Russian thistle, but it can be grown fairly successfully on the heavier soils. Fall and spring rye are grown extensively on the sandy soils and appear to be well adapted to such areas. Preliminary trials are now under way to discover the possible extent to which winter wheat is adapted to this soil zone.

THE DARK BROWN SOIL ZONE

In the dark brown soil zone moisture is also a very important factor influencing crop production. In the main, soil moisture conditions are slightly more favourable than in the brown soil zone and the three-year rotation of fallow, wheat, coarse grain is commonly used. Yield levels are slightly higher than in the brown soil zone although there is also a considerable reduction in the yield of second-crop grain after fallow. On the ten station farms at Goodlands in Manitoba; Carmichael, Radville, Strasbourg, Tugaske and Rosetown in Saskatchewan, and Claresholm, Craigmyle, Drumheller and Nobleford in Alberta 100 crops of wheat on fallow and wheat on stubble have been grown and the yields compared. The records obtained through identical years show an average yield of 20·6 bushels of wheat per acre for the first crop after fallow and 13·1 bushels on the second crop. In part of the area bordering on the brown soil zone, where moisture conditions are less favourable, the two-year rotation of fallow-grain is often used. In more favourable moisture areas the rotation is often extended to include forage crops to assist in soil improvement and, in a certain measure, to control soil drifting.

Generally speaking, coarse grains make a more satisfactory second crop than does wheat. On stations in most parts of the dark brown soil zone it has been found that its is good policy to seed on fallow part of the coarse grains, particularly oats which benefit from early seeding. Flax has been found to be a fairly certain stubble crop provided that weeds are controlled. Crested wheat grass, brome, and alfalfa are suitable forage crops for this region. When it is necessary to use grass and legume crops for soil improvement one or more fields as required are seeded down for pasture or hay, left for a few years until a good sod is formed, then broken up and other land seeded down.

THE BLACK SOIL ZONE

More favourable moisture conditions usually prevail in the black soil areas. This allows an extension of the crop rotation and a reduction in the proportion of summerfallow in relation to the acres of cropland in the farm. The area of black soils is favourable to the production of grass and legume crops, and often these are included in the crop sequence. These along with coarse grains can be used profitably in the production of livestock and livestock products. Weeds are a serious problem throughout this zone particularly in the eastern part where perennials such as sow thistle and Canada thistle, and annuals, especially wild oats, are troublesome. Experimental work done on the station at Tisdale in Saskatchewan has shown that sod crops have great value in a program of wild oats control.

A rotation of fallow, grain, grain, is being followed in a great part of the black soil area, where grain production still constitutes the main type of farming. However, in this soil zone there is also a reduction in yield of the second wheat crop after fallow. A total of 48 yields taken in a fallow, wheat, wheat rotation on the substation farms at Crystal City and Lyleton in Manitoba, Alameda and Yorkton in Saskatchewan, and Pincher Creek in Alberta record an average of 25·0 bushels for first-crop wheat and 15·8 bushels on the second crop after fallow. It has been found more advisable to grow coarse grain as the second crop after summerfallow and to include hay crops in the rotation.

A variation in the fallow-wheat and fallow-coarse grain rotations has been under study on the substation at Alameda, Sask., in the black soil zone. Falconer corn is seeded at 30 pounds per acre, in rows 8 feet apart, as a summerfallow substitute. In this rotation the grain stubble is one-way disked prior to seeding the corn. Subsequent cultivations are performed as required in order to control weeds and conserve moisture. When the corn is removed in the fall the stubble is fall worked and wheat is seeded the following spring. Through seven years an average yield of 10·62 tons per acre of corn fodder has been recorded. Wheat in the second year has averaged 19·3 bushels per acre in comparison with 25·0 bushels on standard fallow. In areas where moisture supplies are plentiful and extra feed is required this practice has some merit. In drier areas this rotation is not favoured.

GREY WOODED AND TRANSITIONAL SOILS

Rotational studies have been conducted on the thirteen grey wooded soils stations located at Baldonnel and Progress in British Columbia, Athabaska, Chedderville, Black Duck, Debolt, Fallis, Goodfare, McLennan and Wapiti in Alberta, and at North Makwa, Snowden and Star City in Saskatchewan. Results of these studies have shown that it is essential to include legumes and grasses in the cropping sequence on these soils. The legumes usually seeded on the stations are either sweet clover or alfalfa. Where legume seed production is desired only one of these should be seeded on the same farm to avoid impurities in harvested seed. These crops may be harvested for seed or hay, as their chief value lies in the penetration of the subsoil and their general beneficial influence on soil tilth. When legumes are grown, and manure is used, along with a small amount of sulphur carrying fertilizers, excellent crops are obtainable on these grey soils. On the stations in these areas it has been found to be generally advantageous to include one year of summerfallow, or at least partial summerfallow, in the cropping cycle. This allows for weed control and the conservation of moisture in the drier districts. A typical rotation on these soils is first year, fallow; second year, wheat; third year, coarse grain; with the fourth, fifth and sixth years in hay. The sixth year hay field is broken as soon as the crop is removed, preparatory to summerfallow in the following season. There are many variations of this rotation which are used with considerable success.

MEDIUM AND LONG TERM ROTATIONS

Adaptations of medium and long-term rotations including wheat, coarse grains, and hay crops are under study on stations in mixed farming areas on the prairies as well as on the grey wooded soils. These vary in duration from four to eight years. Each is designed to meet a specific set of conditions and at the same time to permit the development of a program of moisture conservation and weed control.

Four-Year Rotations.—While other types of four-year rotations have been investigated and discarded as impracticable three distinct four-year crop sequences are under study on station farms. These are as follows:

1. Summerfallow, Wheat, Coarse Grain, Hay 3 years.
2. Wheat, Coarse Grain, Coarse Grain, Hay 3 years.
3. Summerfallow, Wheat, Hay, Coarse Grain.

Rotations 1 and 2 as above listed have been tested and compared on the Illustration Station at Weirdale in Saskatchewan through a five-year period. Such rotations have value in areas where wild oats constitute a problem and leaving the hay crop down for three years is a useful method of control. These rotations fit in well with livestock enterprises, in that a considerable quantity of forage is harvested each year. Under the conditions encountered at Weirdale, production in rotation 2 with no summerfallow year, has been as well sustained as in rotation 1 which has one year of fallow, particularly when the extra crop of grain is taken into consideration. Yields of wheat and coarse grain in rotation 1 were 27·2 and 27·7 bushels respectively, in comparison with 23·2 bushels of wheat and 26·7 and 27·8 bushels of coarse grains in the first, second and third years of rotation 2.

Rotation No. 3 is a typical mixed-farming rotation which is adaptable to more arid areas where one year of summerfallow is required for moisture conservation and weed control. This crop sequence is under study on the station farms at Goodfare and Progress in the Peace River District, Yorkton in Saskatchewan and Eriksdale, Crystal City, Goodlands, Hargrave and Lyleton in Manitoba. Wheat yields have been well sustained, ranging from a low of 10·5 bushels per acre at Goodfare on grey wooded soil, to a high of 29·9 bushels per acre at Hargrave in the black soil zone of southwestern Manitoba. Yields of coarse grains, either barley or oats, have ranged from 28·1 bushels at Yorkton to 55·8 bushels at Hargrave. The lowest yields of hay were recorded at Eriksdale and Hargrave where respective ten- and eight-year averages of 1·0 ton per acre were recorded. The highest yield, of 1·97 tons, was recorded at Yorkton, Sask. through a ten-year period.

Five-Year Rotations.—An extension of the crop sequence to a rotation of five-year duration in districts where moisture conditions are favourable permits the expansion of the area devoted to either coarse grains or hay as sources of feed. Where weeds are a problem a summerfallow year is included. The types of five-year rotations under study which give this degree of flexibility are as follows:

1. IS-WI.51: Fallow, Wheat, Hay, Wheat, Coarse Grains.
2. IS-WI.52: Coarse Grain, Coarse Grain, Coarse Grain, Hay, Hay.
3. IS-WI.53: Coarse Grain, Coarse Grain, Hay, Hay, Hay.
4. IS-WI.54: Summerfallow, Wheat, Coarse Grain, Hay, Hay.
5. IS-WI.56: Fallow, Wheat, Hay, Coarse Grain, Alfalfa 5 years.

Rotations 4 and 5 have been compared at Parkside through a twelve-year period. While grain yields were fairly constant in both sequences yields of hay were somewhat higher in rotation 4. Cultural operations in rotation 5 with two years of breaking out of sod tend to be somewhat more expensive than for rotation No. 4.

Six-Year Rotations.—Six-year rotations are under study at Baldonnel, in the Peace River District; Chauvin, Red Deer and St. Paul in central Alberta, and at White Fox, Guernsey, Glenbush and Birch Hills in Saskatchewan. The most common type of six-year rotation has the following sequence of crops; Fallow, wheat, hay, hay, coarse grain, coarse grain. This sequence is under study at Baldonnel, Guernsey, Chauvin, Red Deer and St. Paul. Where pasture is provided on tillable land such as at Chauvin, Red Deer and St. Paul, the second-year hay field is grazed by livestock, broken early and prepared for coarse grains the following year. Second-year hay crops are harvested at Baldonnel and Guernsey and the field is ploughed shortly after the hay crop is removed. Yields have been quite satisfactory in this rotation, with wheat ranging from 19·7 to 26·0 bushels per acre, coarse grains from 27·5 to 40·0 bushels and hay from 1·00 tons to 1·62 tons per acre.

FIG. 4.—Long-term rotations permit building up feed reserves. Stacks of alfalfa and brome hay from field in 8-year rotation on Illustration Station at Gilbert Plains, Manitoba. Aftermath from hay crop in foreground will provide pasturage right up to killing frosts.

Long-Term Rotations on Paired Fields.—Longer-term rotations extending to eight years duration have been followed with satisfactory results on the station farms in the western mixed-farming areas. This type of rotation has been quite widely adopted in Manitoba in districts where livestock enterprises require the production of forage crops and the provision for areas of pasture on cropland.

Although other arrangements of crops are possible within the rotation of fallow, wheat, grain, hay, pasture, sod breaking, grain, grain, this sequence is followed on the greatest number of stations in Manitoba.

The advantages of such a rotation may be listed as follows:—

(a) Forages are down longer and consequently there is increased benefit to the soil.

(b) Stubble or bare fallow occupies only one-eighth of the land.

(c) Cross-fencing is reduced by pairing of fields. (e.g. fallow and pasture together).

(d) Weed control is facilitated by combining the useful effects of grass with judicious cultural methods.

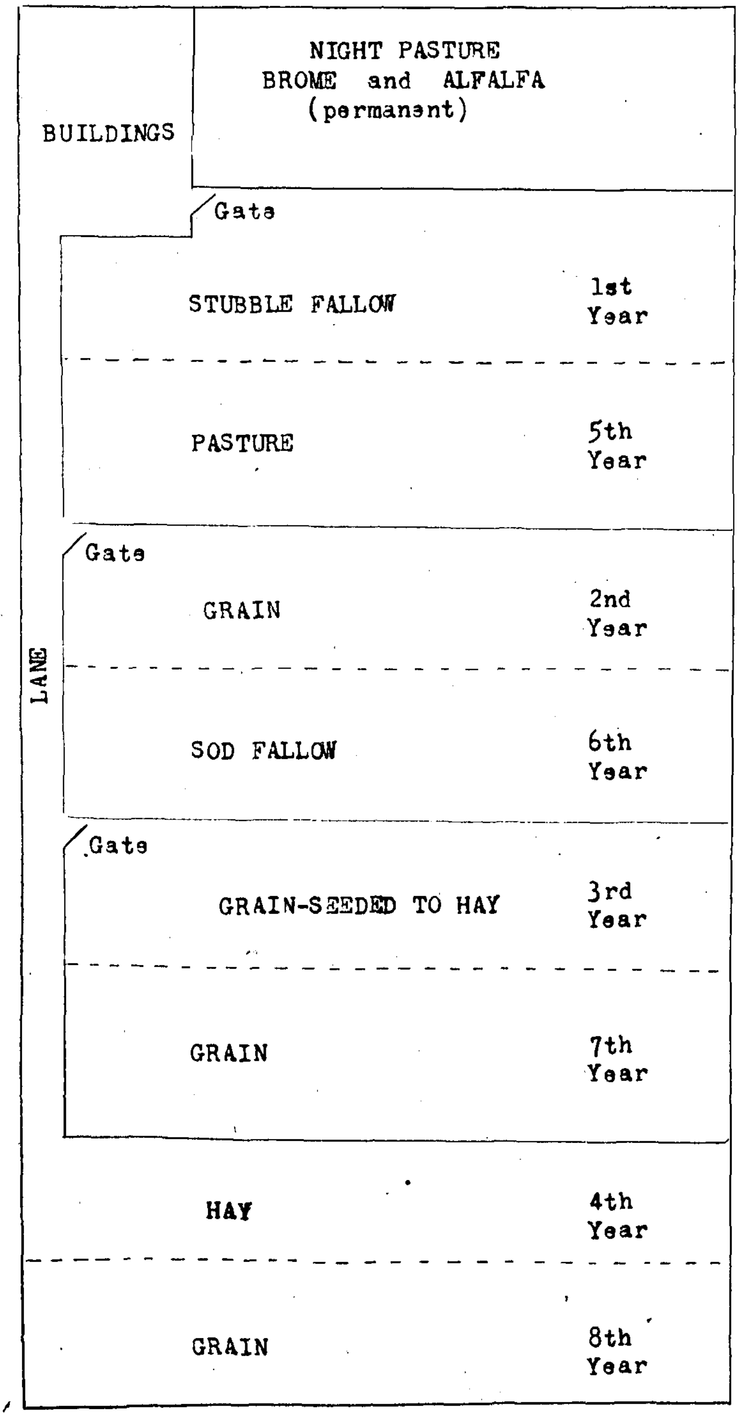
(e) A full year is allowed for sod breaking.

(f) Labour is well distributed throughout the cropping season, and there is no need to break the pasture or hay field in late summer, as is necessary in rotations where the field in grass is specified as pasture and break.

Even though disadvantages such as seeding grass down on second crop after fallow cannot be overlooked in this crop sequence it has been found that early seeding of forage crops has given satisfactory stands. Usually a mixture including a legume and a grass is seeded unless seed production is desired. Brome grass at 12 pounds with alfalfa at 3 pounds per acre has proved to be a productive seed mixture even in drier areas. Replacing half of the brome grass with 6 pounds of crested wheat grass in very dry districts will give greater assurance of fairly well sustained hay crops and productive pastures. In the moister areas the use of a mixture such as brome 5 pounds, timothy 2 pounds, kentucky blue 1 pound, and alfalfa 3 to 4 pounds per acre has given good hay crops, and the planted area will remain productive throughout the course of the rotation. If required, it can be left down for from four to five years. In the main, wheat has been found to be the best nurse crop with barley as the second choice. When seeding down, packing both before and after seeding is recommended and the depth of seeding of legumes and grasses should be from 1 to 1½ inches. Mixtures of a legume and a grass usually assure a better stand and higher production than either seeded alone.

The yields recorded on eight station farms at Arborg, Dugald, Gilbert Plains, Hargrave, Katrime, Lenswood, Silverton and Swan River in Manitoba, over a period of ten years, show sustained production in these long-term rotations. Wheat has yielded 26·6 bushels per acre after fallow and 27·7 bushels after sod breaking. Coarse grains after sod breaking have averaged 36·0 bushels. Hay yields throughout the period under study averaged 1·40 tons per acre.

The field design of a typical eight-year rotation on paired fields is outlined in Figure 5. This rotation is established on the Illustration Station farm at Gilbert Plains, Man. It will be observed that one half of this 320-acre farm is in grain each year, one eighth each in pasture, stubble fallow, sod fallow, and hay. The terms "stubble fallow" and "sod fallow" are used to differentiate respectively between summerfallow following a grain crop and summerfallow following pasture. An eight-year rotation such as this one can be arranged so that a fence between every second field is all that is necessary to have full use of the farm for pasture. The stubble fallow and pasture fields are paired, and other fields in the rotation are paired as marked on the plan. When a farm is fully organized according to this plan the paired crops fall in the appropriately paired fields each year.



Legend: ———— Fences. - - - - - - Dividing lines between paired fields.

FIG. 5.—Field Design: 8-Year Rotation with Paired Fields, Illustration Station, Gilbert Plains, Man.

WEED CONTROL STUDIES

Studies in connection with weed control and eradication on Illustration Station and District Experiment Substation farms are conducted under two broad methods of approach. Crop sequence and cultural practices have been under study for a number of years and with the advent of selective sprays investigations into chemical methods have been used as a supplement to cultural procedures. In the main, specific weeds have required specific control measures according to the conditions of soil and climate encountered. Some of the more important species dealt with and the methods of control developed are outlined below.

Couch Grass

Couch grass is one of the most pernicious weeds with which farmers in more humid areas have to contend. Crop losses due to reduced yields, particularly on land broken from sod, have been extensive and the labour involved in controlling couch grass growth in hoed crops such as corn and potatoes has contributed to greatly increased costs of production. On Illustration Stations in Eastern Canada attempts to eradicate couch grass by cultivation of the hoed crops have in the main been unsuccessful. Results of studies conducted on stations show that, where land is infested, after harvest cultivation the year prior to seeding the hoed crop is the most effective control measure. The procedure followed consists of ploughing shallow early in August after the hay crop has been removed from the field which is destined for hoed crops the following year. The furrow slice should be turned over flat rather than set up as for ordinary fall ploughing. The use of the land roller following ploughing to further compact the land is a recommended practice. Following ploughing and rolling a light stroke with the spike-tooth harrow to fill crevices between the furrows is advisable. Care should be exercised to avoid turning back of the ploughed furrows. Cultivation of the area should begin about ten days following the preliminary treatment. The purpose of the resting period between ploughing and subsequent tillage is to allow for decomposition of the sod. All tillage operations should be shallow with only sufficient penetration to assure eradication of green growth. Hot dry weather is essential to the success of this practice hence preliminary work must be done early in August. After-harvest cultivation started in late August or early September is rarely successful in normal seasons. Following the shallow ploughing and cultivation during the hot dry weather a second and deeper ploughing is done in the fall prior to freezeup. Where this program has been followed carefully very effective control of couch grass has resulted. Variations in this procedure such as early ploughing, cultivation and seeding to a smother crop of buckwheat have been attempted on station farms but the degree of control has not been as satisfactory. In Western Canada summerfallow has been found to be the most generally effective means of control. In both Eastern and Western Canada studies on station farms have shown that proper tillage coupled with clean seed, maintenance of soil fertility, vigorous hay and pasture swards containing desirable legumes such as alfalfa, were effective in keeping weeds, particularly couch grass, out of clean land.

Wild Oats

Contrary to results with broadleaved species of weeds, selective sprays so far developed have been ineffective in the control of wild oats. Tests have shown that black summerfallowing, where the land has been worked over frequently throughout the crop season, has not been overly successful, particularly in years with limited amounts of moisture. Delayed spring cultivation and seeding has been one of the most effective methods of controlling wild oats but it does not always work out satisfactorily due to reductions in yields, and in the northern prairie areas frost damage has lowered the quality of the grain. When this practice is followed only early-maturing grains should be seeded. Experiments have shown that after-seeding cultivation has resulted in marked decreases in the wild oat infestations in the growing grain. Several tests using the rod weeder four to five days after seeding the crop have given marked reduction in wild oats infestation resulting in increased yields of grain.

In the main the above cultural practices conducted within the structure of crop sequences where hay crops are left down for two or three years have proved to be the most effective methods of control. A wild oats control project was conducted through five consecutive years on the Illustration Station farm at Tisdale in Saskatchewan. Nine fields were used in the test and nine different crop sequences were run concurrently throughout the duration of the experiment. Each rotation or crop sequence was confined to an individual field and the arrangement was such that all fields were in spring wheat the year the project was completed. In the final year of the experiment ten-square-yard counts of plants were taken from each field to obtain the percentage of wild oat plants in the standing crop. To arrive at the percentage of wild oats in the threshed grain, samples were taken at harvest time. The crop sequences followed the percentage of wild oats in the stand, and the yield per acre of clean seed are set forth in Table 1.

These data indicate a substantial reduction in the wild oats population through the inclusion of two or more hay crops. In a comparison of the data derived from the standard fallow, wheat, wheat sequence on field 9 with fields 7 and 8, which each carried two complete hay crops, it will be observed that the infestation in the standard grain rotation was considerably greater. A combination of delayed seeding of barley in two consecutive years followed by two hays and then wheat such as in field 3 has apparently given better control than sequences 7 and 8 which included a fallow year. In field 4 it was not possible to effect a marked reduction in infestation where no hay crops were seeded down and delayed seeding of cereals plus one fallow year represented the only control methods.

Leafy Spurge

Studies on the control of leafy spurge have been conducted on the District Experiment Substation farm at Red Deer, Alta. In the initial instance it was found that two years or more of black fallow gave quite effective control; however, in many cases tillage operations contributed to the spread of the weed to non-infested areas in the fields. Supplementary spot treatment with sodium chlorate and more recently with 2,4-D have given control of above-ground growth on small areas where tillage operations did not achieve complete eradication. As yet it has not been possible at Red Deer to eradicate leafy spurge with 2,4-D but by killing off the aerial growth the weed does not compete with the grain crop.

Hoary Cress

Investigations on methods of control for hoary cress have been conducted on the Illustration Station farm at Armstrong in British Columbia and at Dalroy in Alberta, where a special project station was established to deal solely with this weed. The original work at Armstrong was instituted in 1940. In the early years control measures such as the laying down of building paper, boards and straw mulch to smother infested patches were tried, without success. Treatments with sodium chlorate, sulphamic acid, arsenic pentoxide, sinox and atlacide were made in 1941. A total of 600 pounds per acre of chemical applied in three applications gave some control on sodium chlorate treated plots but when the area was ploughed in 1943 hoary cress shoots reappeared although weak in appearance. Spot treatments with sodium chlorate made in 1943 remained void of all growth until 1946 when new shoots began to appear.

TABLE 1.—THE EFFECT OF CROP SEQUENCE AND TILLAGE PRACTICES ON THE CONTROL OF WILD OATS AT TISDALE, SASK. DURING THE FIVE YEARS 1935 TO 1939 INCLUSIVE

	Crop Sequence					Percent Wild Oats in Stand	Percent Wild Oat Seed in Grain	Yield Per Acre Cleaned Seed
						%	%	bu.
No. 1	Wheat	Oat Hay (Alf. 8 lb. W. Rye 10 lb.)	Hay	Hay and break	Wheat	5·75	0·49	39·4
No. 2	Wheat	Oat Hay (Sweet clover 15 lb.)	Hay and break	Fallow	Wheat	0·65	0·16	45·0
No. 3	Fallow to June 10 barley, disk after harvest.	Fallow to June 10 barley, W. Rye 10 Alf. 10, clover 5.	Hay	Hay and break	Wheat	1·33	0·02	35·2
No. 4	Fallow	Fallow to June 15 oats for green feed.	Fallow to June 15, barley.	Fallow	Wheat	17·72	1·42	38·9
No. 5	Fallow to June 15 barley, disk after harvest.	Fallow	Fallow to June 15, seed barley.	Fallow	Wheat	3·34	0·15	42·7
No. 6	Fallow to June 15 Oats for green feed, Sweet clover 15 lb.	Hay and break.	Fallow to June 15, seed barley.	Fallow	Wheat	0·31	0·10	49·5
No. 7	Fallow to June 15 seed, W. Rye 10 lb. S. Clover 6, Alf. 6.	Hay	Hay and break	Fallow	Wheat	7·72	0·95	40·2
No. 8	Fallow to June 15 Oats for hay W. Rye 10 lb., S. Clover 6, Alf. 6.	Hay	Hay and break	Fallow	Wheat	7·95	0·54	41·6
No. 9	Fallow	Wheat	Wheat	Fallow	Wheat	25·52	3·03	34·6

Results of cultural studies at Armstrong show that three years of black summerfallow will give a high degree of control of hoary cress. At Dalroy, where the work undertaken in 1946 consisted of nineteen crop sequence studies

FIG. 6.—Hoary cress at Armstrong B.C. A combination of tillage, herbicides and the use of competition crops aids materially in the control of this weed.

and cultural methods, observations in the fall of 1947 indicated that the stand of hoary cress had been substantially reduced by two seasons of continuous cultivation. Successive years of fallow as a control measure is not always feasible in view of the loss of production from areas under treatment and a modification of one year of fallow, seeded to fall wheat and seeded down to crested wheat and alfalfa followed by spot treatment with 2,4-D has given fairly satisfactory control at Armstrong. While alfalfa in the treated areas is killed out, crested wheat grass seeded in the fall has withstood applications of 2,4-D. At Dalroy a combination of fallow followed by spring or fall rye has reduced the population and strength of hoary cress plants. Barley and wheat have not proved satisfactory as competition crops for hoary cress at Dalroy in that where these crops were seeded the weed showed very little loss of vigour.

CONTOUR FARMING AND WATER EROSION CONTROL

Gullies washed out by a sudden downpour of rain, networks of small runways made on sloping fields by run-off water, washing of soil between the rows of cultivated crops such as corn and potatoes planted lengthwise on slopes, these are constant reminders of the damage caused by water erosion. Soil destruction of this kind is very common in the rolling or hilly sections of the Maritime Provinces where potatoes are grown on a commercial scale, and in the areas immediately east of the Rocky Mountain foothills where the land is sloping and traversed by numerous waterways varying from shallow draws to deep gullies. This type of erosion also obtains on the open prairies even though annual precipitation is only 50 to 75 per cent of that received in more humid regions. With these facts in mind, projects which embody contour farming, contour dykes and grassed runways, have been instituted on the Illustration Station farm at East Centreville, New Brunswick and on the District Experiment Substation farms at Pincher Creek, Nobleford and Drumheller in Alberta to study methods of water erosion control. A modified type of project was also conducted on the Substation farm at Boissevain in southwestern Manitoba.

The project at East Centreville was undertaken in 1946 on a hillside field with a slope varying from 0 to 15 per cent. On this field a diversion ditch 700

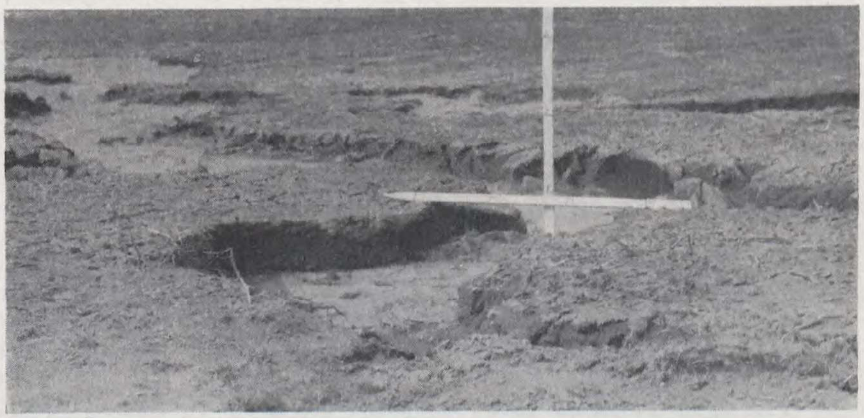


FIG. 7.—Gullying caused by run-off water. Erosion of this type can be levelled out by tillage but the top soil loss is irreplaceable.

feet in length and 18 feet in width was constructed, with a fall of one foot per hundred feet in length. The equipment required was a small grader type ditcher hauled by the farm tractor. The following spring the ditch bottom was limed, fertilized and seeded to grass and clover. A natural waterway which carried run-off water from an adjoining farm has also been left in sod. Two fields have been established above the diversion ditch and one below and these are cropped in a three year rotation of potatoes, oats and clover. In cultivating and planting the fields the contour of the diversion ditch is followed. In the two years this project has been operative, readily observable soil losses have been greatly reduced. During the spring the diversion ditch catches the heavy run-off and carries it off slowly. During the growing season each potato row forms a small dam on the contour around the slope thus holding the water while the close growing clover and grain crops in the other two fields impede the passage of water and maintain a protective cover on the soil.

At Pincher Creek the farm ranch organization which involves the maintenance of forage supplies permits the use of a system of contour dykes and contour stripping. The original work done in 1936 consisted of the building of contour dykes to divert run-off water. These were constructed using a four-bottom plough and a small road grader and were located at four points along a half-mile draw. These dykes, varying from 300 to 1,300 feet in length, are led to one or both sides of the draw to places that are reasonably level to facilitate spreading the water. Gully erosion was effectively controlled by contour dykes but sheet erosion continued to be a problem on the side slopes on both sides of the draw and contour stripping was instituted in 1940. Using contour lines as a guide the field was divided into four strips. Two of these containing a total of about 50 acres were seeded to a mixture of alfalfa and brome grass. The two alternate strips produce cereal crops and are fallowed only when weed infestations or lack of moisture seem to make it advisable. The combination of contour dykes and contour farming has proved very effective. Water erosion has been controlled both on the wide slopes and in the draws and rainfall is more evenly distributed through the prevention of run-off. Seeding operations and harvesting are facilitated since the land in each field dries uniformly and the ensuing crop ripens more evenly. Less power is required for field operations where implements work more on the level rather than up and down relatively steep grades.

At Nobleford a 100-acre field was farmed on contour in 1946 and 1947 and in both years the field was completely seeded to grain. The first procedure was to seed two long contour parallel strips. The corners and irregular interspaces were then seeded to the same grain rather than to a forage crop, in view of the limited feed requirements. Cereal crops seeded on the contour have offered considerable resistance to soil movement by water and a high degree of erosion control has been achieved. The annual rainfall at Nobleford is approximately 15 inches, 6 inches less than at Pincher Creek but the benefits are similar at both locations.

Supplementary procedures such as the seeding down of drainage ways to brome grass at both Pincher Creek and Nobleford has controlled erosion even

FIG. 8.—(Upper): Equipment used to construct diversion ditch, East Centreville Illustration Station.
(Lower): Almost completed ditch ready for fertilization and seeding to grass.

though spring run-off is frequently very heavy. Results of work done on other Illustration Station and Substation farms show that a system of erosion control can be fitted into the cropping system according to the particular type of production required. Such systems need not necessarily be elaborate and in most cases can be established using equipment already available on the farm. In the main, strongly rolling land has not been satisfactory for contour farming but its use on relatively wide slopes on Illustration Station and District Experiment Substation farms has been an important aid in soil conservation and increased productivity.

STRIP FARMING AND SOIL DRIFT CONTROL

Strip farming projects were established in 1935 on 47 District Experiment Substation farms in Manitoba, Saskatchewan and Alberta, to study the effectiveness of this method of soil drift control over a wide range of soil and climatic conditions. Records assembled since 1936 indicate quite clearly that the danger of soil drifting will always be a problem for prairie farmers and that at the same time a great deal can be accomplished when a constructive program of soil drift control has been established. Soil drifting has been prevalent in varying degrees of severity all through the open prairies, in the park belt, and as far north as the Peace River district of Alberta and British Columbia. The area most subject to soil drifting lies in southern Alberta and southwestern Saskatchewan. In this chinook belt high winds are frequent and, with the exception of the extreme western part of southern Alberta, precipitation is low and evaporation is high.

Strip farming as a control measure lends itself easily to farming practice on the prairies where cereals are grown largely on summerfallow. When following such a rotation the farm is laid out in long strips with crop and fallow strips alternating. A system of strip farming can also be used with longer rotations as is done in the mixed-farming area of southwestern Manitoba. The procedure followed on the Substation farms was the laying out of the land areas in strips varying from 8 to 20 rods wide, with 16 rods being the width most commonly used. On the medium textured soils where soil movement was less severe, the prevailing widths were 16 to 20 rods while on fine sandy loams and clays, strips

FIG. 9.—Soil drifting remains a problem and control measures are under constant study on the stations in the areas affected.

of 10 to 13⅓ rods were used. The ideal direction of strips is at right angles to the prevailing winds. In the chinook belt of southern Alberta where west and southwest winds are most prevalent, strips were run in a north and south direction. In central Alberta, southern Saskatchewan, and southwestern Manitoba the prevailing winds are not so easily determined, therefore the directions of strips were either north and south or east and west to suit the convenience of field operations.

Weather conditions still continue to be a most important factor determining the extensiveness of soil drifting in any year. Careful observations on southern Alberta substation farms indicate that regardless of the most effective methods of control now instituted, wind erosion can occur during unfavourable periods. During the four-year period 1936 to 1939 inclusive, medium to severe drifting occurred on the average of once per station per year. In the five-year period 1940 to 1944 inclusive wind damage was negligible. A return of unfavourable weather in 1945 and 1946 gave rise to the occurrence of soil drifting on substation farms on the average of one and one-half times per station per year. Favourable weather followed in 1947 and little difficulty was experienced. It is accepted that weather conditions cannot be controlled and that they constitute a most important factor influencing the problem of soil drifting.

Strip farming alone, without attention to tillage practices, has not been a completely effective method of soil drift control. The piling up of soil on the edges of strips was ample evidence that the development of methods of summer-fallowing designed to prevent soil drifting as well as to conserve moisture was urgently required. Attention was directed to controlling drifting on fallow strips. This necessitated procedures that prevented moisture-consuming weed growth and which left the land protected by a good trash cover. Various types of implements such as the one-way disk, duck-foot cultivator and rod weeder have been used with varying success. Blade-type cultivators have been tested extensively on substation farms since 1943. An advantage of this type of machine is that even after several strokes almost all the trash remains on the surface to give protection to the soil. It has been found that the various types

Fig. 10.—The blade cultivator anchors the trash cover and is a most useful machine for moisture conservation and soil drift control.

of blade cultivators can be used satisfactorily under a wide range of soil and moisture conditions. Weeds have been controlled most effectively by blading as soon as possible following a rain rather than waiting for hot, bright weather, as this practice usually ensures a longer dry period following tillage and a more satisfactory kill of weed growth.

Under less favourable conditions which have been encountered on District Experiment Substation farms certain modifications in procedures have been required. There have been instances when stubble was not sufficient to provide an effective trash cover and emergency methods were employed. Ploughing as a last operation of the season on medium textured soils has provided a lumpy surface to give protection against the wind. Listing of fallow strips has also been followed extensively on the Substations in southwestern Saskatchewan and southern Alberta on soil textures ranging from sandy loam to clay. The vulnerability of strip farming to sawfly attack prompted the development of a modified strip system on the substation farms at Kincaid, Limerick, Gravelbourg and Shackleton in Saskatchewan in 1939. Under this system the land is divided into strips 16 rods wide alternating with strips 28 feet in width. When the wide strips were in fallow the narrow strips were seeded to oats, a sawfly-resistant crop. The following year the wide strips were seeded to wheat and the narrow ones were fallowed. In more recent years the widths of both the wide and narrow strips have been increased. Careful observations indicate that this modified system of strip farming has been fully as effective in controlling soil drifting as the regular system.

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

Experiments to determine the effect of the depth of moist soil at seeding time on yields of wheat were instituted on District Experiment Substation farms in the light brown soil zone of southwestern Saskatchewan in 1944. These experiments have been expanded and are now conducted on 13 station farms in southwestern Saskatchewan, 7 in northwestern Saskatchewan, 9 in northeastern Saskatchewan, 9 in southeastern Saskatchewan and 10 in southern Alberta. The soil zones represented by the 48 station farms where this investigation is in progress comprise the light brown, dark brown, black, transitional and grey wooded soils. Consequently the results obtained provide an indication of what can be expected in the way of crop yields in the various soil zones under varying conditions from the standpoint of moisture reserves.

In order to determine the depth of moist soil, holes were bored with an auger at several points in the field. Care was taken to select locations which were fairly representative of the area involved. The soil was considered moist if it would stick together when pressed into a ball in the hands. Harvesting of the crop was done in the regular manner and the yield was recorded. The number of records obtained and the average yields are summarized in Table 2. Up to the present time, 223 records have been obtained; 126 in the light brown soil zone, 57 in the dark brown, and 40 in the black, transition and grey wooded soil zones. The latter three zones have been grouped together due to insufficient records for any single zone.

In general, it will be noted that in the light brown soil zone 30 per cent of records on fallow and 70 per cent of records on stubble show a depth of moisture at seeding time of 25 inches or less compared with 8 per cent of records on fallow and 54 per cent on stubble in the other soil zones combined. In the main the average yield of wheat obtained from a given depth of moisture was greater on the darker soil. It may be noted, however, that the difference in average yield between fallow and stubble for each zone remained fairly constant at or near 5 bushels per acre.

TABLE 2.—EFFECT OF DEPTH OF MOIST SOIL AT SEEDING TIME ON YIELDS OF WHEAT 1944-1947 INCLUSIVE

Substations in Saskatchewan and Southern Alberta

Soil Zone	Depth of moist soil	On fallow		On stubble		Total number of records	Average yield of all records
		Number of records	Average yield	Number of records	Average yield		
	in.		bu.		bu.		bu.
Light Brown	0–18	11	8·0	19	6·3	30	7·0
	19–25	12	9·9	15	7·6	27	8·6
	26–35	12	11·3	5	10·3	17	11·0
	36–43	18	14·7	5	11·4	23	14·0
	44 plus	25	18·3	4	17·2	29	18·1
		78	13·6	48	8·6	126	11·7
Dark Brown	0–18	0	–	4	13·2	4	13·2
	19–25	1	9·0	5	11·8	6	11·3
	26–35	5	16·1	4	15·2	9	15·7
	36–43	5	21·4	3	14·2	8	18·7
	44 plus	22	20·8	8	17·6	30	19·9
		33	19·8	24	14·8	57	17·7
Black Transition and Grey Wooded	0–18	1	13·0	2	10·2	3	11·1
	19–25	3	23·2	3	19·0	6	21·1
	26–35	4	12·8	1	24·5	5	15·1
	36–43	9	23·9	1	27·3	10	24·2
	44 plus	11	25·5	5	16·3	16	22·6
		28	22·4	12	17·5	40	21·0

In the light brown soil zone, with an average yield on stubble of 8·6 bushels per acre, a 5-bushel increase is of considerable importance. In the black soil zone where the average yield on stubble is 17·5 bushels per acre an increase of 4·9 bushels due to fallow is of much less importance. In the brown soil zones the average yields on stubble for any given depth of moisture have been lower, in most cases, than on fallow. Individual records, however, show that where the depths are the same on fallow and stubble, provided there is no insect damage, the yields have been approximately the same. In many cases crops on stubble have been more seriously damaged by sawflies, and to a certain extent grasshoppers, than those on fallow, thus tending to reduce the average yield of crops on stubble. Although seasonal rainfall is a very important factor in determining crop yields, it has not been considered in the above statements. Some indication of the variation in crop yields, due to such factors as climatic conditions and soil type, can be obtained from Table 3.

In the light brown soil zones, when the depth of moisture at seeding was 25 inches or less, 67 per cent of crops yielded less than 10 bushels per acre and only 5 per cent yielded over 15 bushels per acre. When the depth of moisture was over 44 inches, only 7 per cent yielded less than 10 bushels per acre and 62 per cent yielded over 15 bushels. As pointed out above only 30 per cent show a depth of moisture in stubble of over 25 inches in this soil zone. The need for summerfallowing and conserving all the moisture possible therefore becomes quite apparent.

In the dark brown soil zone 40 per cent of the records produced less than 10 bushels per acre when the depth of moisture was less than 25 inches, and 20 per cent produced more than 15 bushels. When the depth of moisture was over 44 inches only 10 per cent produced less than 10 bushels and 78 per cent produced over 15 bushels per acre. From the records available to date 37 per cent show a depth of moisture on stubble of less than 25 inches. If these records are an

TABLE 3.—EFFECT OF DEPTH OF MOIST SOIL ON THE FREQUENCY OF YIELDS WITHIN THE VARIOUS RANGES 1944 TO 1947 INCLUSIVE

Soil Zones	Depth of moist soil in.	Total Number of records	Number of records showing yields per acre within the various moisture ranges						
			0–4·9 bu.	5–9·9 bu.	10–14·9 bu.	15–19·9 bu.	20–24·9 bu.	25–29·9 bu.	30 plus bu.
Light Brown	0–18	30	11	12	5	1	1	0	0
	19–25	27	7	8	11	1	0	0	0
	26–35	17	1	6	6	3	1	0	0
	36–43	23	0	6	9	5	1	1	1
	44 plus	29	0	2	9	7	4	6	1
Dark Brown	0–18	4	0	2	1	0	1	0	0
	19–25	6	0	2	3	1	0	0	0
	26–35	9	0	1	4	2	2	0	0
	36–43	8	0	1	1	4	1	0	1
	44 plus	30	0	3	4	8	8	4	3
Black Transition and Grey Wooded	0–18	3	0	1	2	0	0	0	0
	19–25	6	0	2	0	0	3	0	1
	26–35	5	0	1	2	0	2	0	0
	36–43	10	0	0	0	2	3	4	1
	44 plus	16	0	0	2	6	3	3	2

indication of conditions within this zone it would appear that crops can be seeded on stubble land quite frequently.

The effect of depth of soil moisture at seeding time is less pronounced in the black, transition, and grey wooded soils zones than in the brown soil zones. As pointed out previously, it is rather questionable whether it will pay to summer-fallow for moisture conservation in these zones unless the stubble is exceptionally dry.

No attempt has been made to analyse the effect of depth of moisture in the various soil types. It is known, however, that clay soils will hold from 2 to 2½ times as much moisture per foot of depth as sandy loam. Consequently, it would be expected that for similar depths of moisture clay soils would produce higher yields. This is borne out to a certain extent at least by the fact that practically all of the lower yields indicated in the tables were on the lighter soil types. It is suggested therefore that if these data are being used as a guide that due allowance should be made for soil type. In the case of sandy soils yields lower than the average indicated should be expected, whereas in the clay soils somewhat higher yields may be expected for equivalent depths of moisture.

SOIL FERTILITY INVESTIGATIONS ON FIELD CROPS

Soil fertility investigations are an important phase of Illustration Station work. In British Columbia and Eastern Canada where diversified farming is generally practised the number of crops under study is extensive. Fertility work in the plains area of Manitoba, Saskatchewan and Alberta deals largely with the effect of chemical fertilizers on the yield of cereals with particular emphasis on wheat. In the grey wooded soils areas of Saskatchewan, Alberta and British Columbia a broad program of fertility tests is under way to determine the inherent fertility requirements of these relatively new soils. Such investigations provide information to farmers in each district served and also permit comparative studies to be made of the great variety of soil types dealt with throughout the Dominion. This section of the report deals solely with fertilizer experiments on general field crops. Fertility work with special crops such as potatoes, hops, raspberries, is dealt with under discussions dealing directly with those crops.

Plant Food Deficiency Studies in Eastern Canada

Results of a standard plant food deficiency test which was conducted on 72 Illustration Station farms in Ontario, Quebec, Nova Scotia and Prince Edward Island indicate the fertility requirements of the wide range of soil types dealt with. One section of this experiment was designed to test the response of crops to applications of nitrogen, phosphorus and potash. Applications of all three elements were made on the basis of 1,000 pounds per acre of 5–10–5 chemical fertilizer without manure, giving rates of 50 pounds nitrogen (N), 100 pounds phosphorus (P_2O_5), and 50 pounds of potash (K_2O) per acre. Swede turnips were used as the primary crop indicator at all locations.

In Prince Edward Island results from eleven tests show an increase over the check plots, which received neither manure nor fertilizer, of 1·74 tons for nitrogen, 4·54 tons for phosphorus and 1·01 tons from applications of potash. Nine tests in Nova Scotia gave increases of 2·09 tons, 5·41 tons and 0·94 tons for nitrogen, phosphorus and potash respectively. In New Brunswick seven experiments record a net increase of 6·60 tons for phosphorus in comparison with 2·50 tons for nitrogen and 0·35 tons for potash. In Quebec results from thirty-eight experiments gave an average net increase of 1·54 tons for nitrogen, 6·57 tons for phosphorus and 2·54 tons for potash. The greatest increase for phosphorus was 9·60 tons per acre which was recorded on nine station farms in eastern Quebec which comprises the area below Quebec City and includes part of the Gaspé Peninsula. The greatest increases from nitrogen also occurred in this area and in northern Quebec in the clay belt. The most favourable response from potash was in the Eastern Townships of Quebec where eleven experiments on Illustration Station farms recorded a net increase of 3·62 tons due to this element, however phosphorus was also the dominant element in this district recording a net increase in yield of 7·64 tons per acre. Seven tests in eastern and central Ontario recorded increases of 1·27 tons from nitrogen, 4·85 tons for phosphorus and 0·73 tons for potash.

The results from these experiments indicate the great importance of phosphorus in the production of general field crops throughout Eastern Canada. In this area particular attention should be paid to the phosphorus content of purchased mixed fertilizers since this element is normally deficient in most eastern soils.

The Effect of Farm Manure and Varying Rates of Chemical Fertilizer on Crop Yields

Basic soil productivity, the value of farm manure as a source of plant food, and the amount of chemical fertilizer to apply on general field crops are important problems on Eastern Canadian farms. Results from seventy-two experiments on Illustration Station farms in the Eastern Provinces provide information on fertility levels, the value of farm manure and returns from varying rates of complete fertilizer when applied in combination with farm manure. In this experiment manure was applied prior to seeding the hoed crop at the rate of 12 tons per acre and supplemented with 2–12–6 chemical fertilizer at rates of 400, 800, and 1,600 pounds per acre. All treatments were compared with check plots which received neither farm manure nor chemical fertilizer. The yields of swede turnips recorded in this experiment are summarized in Table 4.

Basic soil productivity varies widely in the areas under study. A study of the yields recorded on the check areas shows that, in the main, soils on Illustration Station farms in Prince Edward Island, eastern Quebec, central Quebec and northern Ontario and northern Quebec are low in active organic constituents which promote crop growth. When manure only was applied yields in these areas were increased by more than 100 per cent whereas on the more productive soils the initial increase from manure was approximately 50 per cent. Increased yields for rates of application of 2–12–6 chemical fertilizer above 400 pounds

TABLE 4.—THE EFFECT OF FARM MANURE AND VARYING RATES OF 2-12 6 FERTILIZER ON THE YIELD OF SWEDE TURNIPS ON ILLUSTRATION STATIONS IN THE EASTERN PROVINCES 1938 TO 1947 INCLUSIVE

Province	Number of tests	Treatment per acre				
		Check No treatment	Manure 12 tons	Manure 12 tons + 400 pounds 2-12-6	Manure 12 tons + 800 pounds 2-12-6	Manure 12 tons + 1,600 pounds 2-12-6
		tons	tons	tons	tons	tons
P.E.Island	11	6·91	12·04	14·75	14·91	15·93
Nova Scotia	9	14·10	18·78	21·38	24·43	23·58
New Brunswick	7	11·11	16·73	20·44	22·19	22·90
Eastern Quebec	9	6·94	15·54	19·68	23·04	24·84
Central Quebec	13	5·65	16·69	20·74	23·99	26·28
Western Quebec	8	15·12	23·12	24·81	23·92	24·53
Lake St. John	5	10·57	15·34	17·51	18·90	21·39
Northern Ontario and Quebec	3	4·30	10·30	12·70	12·70	10·20
Central Ontario	4	11·60	16·30	18·70	20·58	23·15
Eastern Ontario	3	11·42	16·62	15·21	17·57	16·60

per acre were hardly sufficient to merit the expense involved. On the average of the seventy-two experiments in all provinces the check areas recorded a yield of 9·50 tons, manure alone at 12 tons 16·43 tons, manure plus 400 pounds per acre of 2–12–6 fertilizer 19·29 tons, manure plus 800 pounds of 2–12–6 fertilizer 21·08 tons, and manure plus 1,600 pounds of 2–12–6 fertilizer 22·07 tons.

All plot areas were seeded to grain the year following the turnip crops and seeded down to a mixture of grasses and clovers. Yields were taken on first and second year hay crops to determine the residual effect of manure and chemical fertilizers which were applied to the turnip crop in the first year of the experiments. Results recorded on 117 crops of first and second year hay show an increase from manure over the check plots of 0·35 tons. On the average, fertilizer treatment at all three rates supplementing the basal treatment of manure recorded an increase of 0·57 tons over the check plot and 0·22 tons over the plots which received manure alone.

Results from this experiment indicate that where general farming is practised the fundamental basis of crop production must be the conservation and judicious use of farm manure. Where sufficient supplies of manure are not available rates of application of chemical fertilizers might of necessity be higher but where the supply is adequate nominal treatment with chemical fertilizers at rates up to 400 pounds per acre should give satisfactory results.

Nitrogenous Fertilizers for Hay Lands

The practice of applying nitrogenous fertilizers early in the spring on timothy meadows has been studied on the Illustration Station farms in New Brunswick, Nova Scotia and Prince Edward Island. Results from other fertility tests show that the nitrogen content of the soils in these provinces is quite low and that residual effects of fertilizers applied in the hoed crop year have largely disappeared by the third or fourth year following fertilization. The results from 133 tests conducted on the stations in New Brunswick through nine years to determine the effect of an application of 125 pounds of nitrate of soda on the yield of timothy hay record an average yield of 2·04 tons per acre in comparison with 1·39 tons on the check plot which received no treatment. Fifty-eight experiments on the Nova Scotia stations recorded an average yield of 2·58 tons per acre from an application of 115 pounds of sulphate of ammonia, 2·61 tons from 100 pounds of nitrate of soda in comparison with 1·93 tons per acre on the plots which received no treatment. In Prince Edward Island where the basic productivity of hay lands is somewhat lower, results from fifty-four tests give an average yield on the untreated plots of 0·83 ton per acre in comparison to 1·36 tons where 115 pounds of sulphate of ammonia was applied and 1·27 tons from an application of granular cyanamid.

FIG. 11.—Farm manure is an important factor in crop production on the light sand soil at St. Etienne des Grès, Que. (Upper): Check plot which received no manure or fertilizer, (Lower): Manure applied at 10 tons per acre in this same experiment yielded 11·62 tons of swedes per acre.

THE EFFECT OF GROUND LIMESTONE ON THE YIELD OF FIELD CROPS

Experimental work dealing with the value of lime has been conducted on Illustration Station farms throughout the five Eastern Provinces. Forty-two experiments conducted on small plots in Ontario, Quebec, New Brunswick, Nova Scotia and P.E. Island where lime at one and three tons per acre was compared with a check plot gave yields of 1·55 tons and 1·70 tons per acre of clover hay respectively in comparison with the check yield of 1·31 tons. In more expansive field tests conducted on large plots on fifty-one station farms in Nova Scotia, New Brunswick and Quebec, finely ground agricultural limestone was applied at one, two and three tons per acre and compared with a check plot which received no lime. The average yield from the fifty-one check plots which received no treatment was 1·23 tons of clover hay per acre in comparison with 1·51 tons from lime at one ton, 1·74 tons from two tons lime and 1·83 tons from the three tons per acre application.

It has been found that the results derived from applications of ground limestone to crops are influenced by a number of factors. On light soils low in organic matter the beneficial results from treatment with limestone are not so apparent as on heavier soils higher in organic matter or on light soils where regular applications of farm manure have been part of farm practices. In general, ground limestone has given beneficial results in Quebec and in the Maritime Provinces. In Ontario this project was undertaken on the stations in the eastern and north central portion of the province, namely, at Williamstown, Caledonia Springs, Bloomfield, Verner and Mindemoya. Results from these tests have shown very little response from lime as a supplement to manure at 10 tons per acre. Conversely on the Lyn station in Leeds county, Ontario, preliminary results of experimental work in 1946 and 1947 indicate that this clay loam soil has a lime requirement and increased yields of mixed grain and hay have been recorded as a result of treatment with lime. In any consideration of the lime question it is a problem of individual soil types and in many cases individual farms. Results of work on Illustration Station farms show rather conclusively that basic productivity and organic matter content must also be a part of a liming program. To illustrate this point the records collected from the standard lime test on the Illustration Station at Pomeroy Ridge in New Brunswick where basic productivity is fairly satisfactory gave yields of 1·5, 2·0, and 1·9 tons of hay per acre respectively for the one, two and three ton applications in comparison with a check yield of 1·5 tons per acre. The same test at St. Charles in New Brunswick, where the prevailing soil is sand and low in organic matter, recorded respective yields of 0·4, 0·3, and 0·4 tons per acre in comparison with 0·7 tons on the check plot. On productive clay loam soil at Makamik in the Abitibi district of northern Quebec this same test on the Illustration Station farm recorded yields of 2·00, 2·33, and 2·77 tons of hay per acre for the respective applications of one, two and three tons per acre of agricultural lime, in comparison with a check yield of 1·98 tons per acre.

Fertility Studies on Grey Wooded and Transitional Soils

Exploration work was started in 1927 on the Illustration Station farm at Chedderville on the grey wooded soils of northern Alberta. The soils of these then sparsely settled regions presented problems in fertility maintenance which were entirely different from those of the plains areas or those generally encountered in the more humid areas in Eastern Canada and southern British Columbia. The influx of settlers into these districts necessitated the expansion of services through the establishment of Illustration Stations on both the transitional and grey wooded soils. To further the work on these soil types four District Experiment Substations, with resident supervisors in charge during the crop season, were established during the period 1945 to 1947 in the grey wooded soils areas within the zones served respectively by the Experimental Stations at Melfort and Scott in Saskatchewan, and Lacombe and Beaverlodge in Alberta.

The effect of sulphur on the growth of crops was brought out clearly in early experiments on these soils. However, when a permanent type of agriculture is visualized for these areas other factors of fertility maintenance and management must also receive attention. Surveys have shown that there are many local variations in the texture of the surface and subsoil, the degree of podsolization, drainage and inherent productivity. These variations are due largely to such factors as parent material, climate and native vegetation. Similar variations occur in the results which are acquired from standard experiments which are conducted on station farms in the different districts served.

On the Chedderville and Fallis stations in Alberta, where favourable moisture conditions usually exist, considerable response is obtained from fertilizers particularly the sulphur carrying forms of nitrogen and phosphorus. This has been most noticeable with hay crops where increases in yields of 0·94 and 0·76 tons per acre were recorded from applications of 80 pounds sulphate of ammonia and 100 pounds 16–20–0 respectively in five tests. Much of the grey soil in the Peace River district is underlain by a rather impervious subsoil. Here results of experiments on Illustration Station farms show that phosphatic fertilizers have increased wheat yields by as much as ten bushels per acre in years of ample moisture, and two to five bushels per acre in years of average moisture supplies. Fertilizer response has been most substantial in the wheat crop following summerfallow but there have been little measurable responses in succeeding crops due to residual effect.

In northeastern Saskatchewan in the Melfort district an eleven-year average increase in wheat yield of 10·8 bushels per acre has been obtained at Carragana, a station located on a mixture of Etomami, Tisdale and Arborfield clay soils. On Whitewood loam soil, at the Weirdale station, 30 pounds of 11–48 per acre has given a five-year average wheat yield increase of 4·0 bushels per acre. Similar results have been obtained at Snowden on Waitville clay loam although at this point there is some indication that forms of phosphorus containing sulphur give best results. Quite different results have been obtained at White Fox on the Shellbrook fine sandy loam soil in that no substantial yield increases have been obtained through the use of fertilizers.

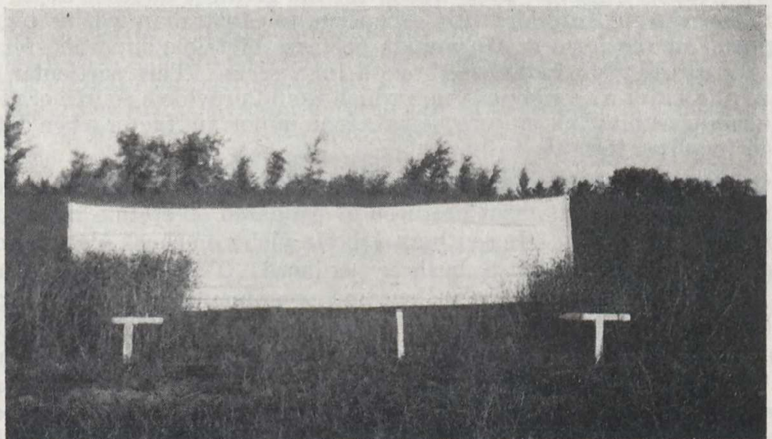
In the Scott supervisory district in northwestern Saskatchewan general yield increases on these soils have been obtained through the use of 11–48–0 and 16–20–0 fertilizer formulae. At Glaslyn on Waitville loam soil and at North Makwa on a mixture of Loon River and Horsehead loam two-year average increases of 1·6 bushels of wheat, 6·7 bushels of oats, and 2·9 bushels of barley have been obtained from the application of 30 pounds of 11–48 per acre.

In the broader phases of fertility maintenance on grey wooded soils it is found that the inclusion of legumes in the crop rotation and the application of farmyard manure have a beneficial effect. In twelve tests located at such widely scattered Illustration Stations as Chedderville, Debolt, Falher, Progress and Snowden, wheat yields in a legume rotation exceeded those in a fallow, wheat, oats rotation by 4·2 bushels per acre. The use of farmyard manure has proved to be one of the most generally effective methods of increasing crop production throughout the grey wooded areas. Increases in yields of cereals and hay crops have been obtained at Chedderville, Falher, Debolt, McLennan, in Alberta, Progress in British Columbia, and North Makwa, Glaslyn and Snowden in Saskatchewan. On the basis of 18 tests conducted on these stations an average increase of 6·8 bushels of wheat per acre has been recorded following an application of 15 tons of manure per acre in the summerfallow year of the rotation.

The Effect of Chemical Fertilizers on the Yield of Cereal Crops

The effect of chemical fertilizers on the yield of cereal crops has been studied on the Illustration Station and District Experiment Substation farms in British Columbia, Alberta, Saskatchewan and Manitoba. These experiments have been conducted in addition to those already reported on grey wooded soils and in the three Prairie Provinces were largely confined to the grain-growing areas on the brown, dark brown, and black park belt soils. In British Columbia high analysis complete fertilizers such as 13–16–12 and 6–30–15 were compared with

11–48–0, 16–20–0 and superphosphate 0–20–0. In the Prairie Provinces 11–48–0, 16–20–0, 2–19–0 and triple superphosphate 43 per cent P_2O_5 were the main analyses under test.



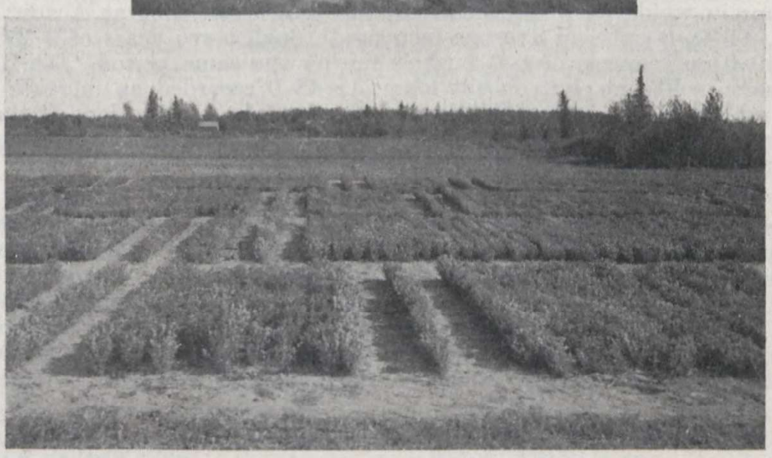


FIG. 12.—Grey wooded soils experiments on Illustration Stations. (Top) Fertilizers on alfalfa at Pierceland, Sask., 1939. Left, barnyard manure at 15 tons plus ammonium phosphate 16–20–0 at 75 pounds per acre; centre, check no manure or fertilizer; right, sulphate of ammonia at 75 pounds per acre. (Middle) Fertilizer on wheat at Baldonnel, B.C., 1947. Left, check; right, ammonium phosphate 16–20–0 at 100 pounds plus potassium sulphate at 40 pounds per acre. (Bottom) Alfalfa plots on the station at Snowden, Sask., 1944.

In the southern interior of British Columbia at Lumby, Salmon Arm and Revelstoke 6-30-15 and 11-48-0 at rates of 150 pounds and 100 pounds per acre respectively have given very satisfactory increases in yields. A combination of nitrogen and phosphorus in a narrow ratio has given the greatest increase at all station farms in the central interior with exception to Australian where phosphate alone applied in the form of 26 pounds per acre of triple superphosphate has given the greatest yield increases through four years. This particular station has grown alfalfa for a number of years which would provide a source of nitrogen. The influence that previous cropping exerts is an important factor when determining which fertilizer formula to apply.

In the Prairie Provinces the value of chemical fertilizers as to their ability to give increased yields of wheat has been investigated on station farms under a wide variety of conditions. In southern Alberta yields on check plots from forty-six experiments averaged 29·8 bushels per acre. Triple superphosphate at rates of 15 to 25 pounds per acre in the same experiments gave an average yield of 29·5 bushels. Applications of 11–48–0 at 15 to 25 pounds per acre and 2–19–0 at 15 to 40 pounds per acre gave respective yields of 31·5 and 31·8 bushels per acre. On the average these records have not shown any great value from fertilizer but in certain soil zones and on particular station farms specific increases have been recorded. At Castor 11–48–0 gave an increase of 2·1 bushels of wheat per acre through three years while response from triple-superphosphate and 2–19–0 was negligible. Results at Drumheller showed rather conclusively through four years that the application of phosphorus fertilizer was beneficial with increases ranging from 3·4 bushels for 2–19–0 to 4·2 bushels from applications of triple superphosphate. At Rockyford applications of 11–48–0 and 2–19–0 gave respective yield increases of 3·5 and 11·1 bushels per acre from rates of application ranging from 15 to 40 pounds per acre. Results at Pincher Creek in the shallow black soil zone through five years record an increase of 2·9 bushels per acre from applications of 11–48–0 at rates of 15 to 50 pounds per acre. In the dark brown soil zone results at Claresholme, Craigmyle and Nobleford have shown little positive response to fertilizer treatment. In the brown soil zone records at Foremost and Whitla, where precipitation is limited, show no positive results from fertilizer treatment and in many cases slight reductions in yields were recorded. In the brown soil zone at Acadia Valley on clay, 11–48–0 gave an average increase through three years of 3·2 bushels and 2–19–0 an increase of 6·0 bushels during the same period. At Bindloss in the same soil zone, but on silt loam, 11–48–0 recorded an increase of 2·6 bushels while at Lomond on clay loam increases from applications of the same fertilizers were not significant. At Metiskow in central Alberta a continuous fertilizer test conducted through ten years has recorded a net increase of 7·2 bushels of wheat per acre.

Results of fertilizer work on five Illustration Station and District Experiment Substation farms in the Scott district of supervision in Saskatchewan in 1947, gave a net increase from fertilizer treatment of only 0·9 bushel. In all cases 11–48–0 at 25 pounds per acre was used. At Conquest in the shelterbelt area an increase of 2·2 bushels was recorded. At Glenbush and Rosetown no positive increases were noted. Further north at Glaslyn and North Makwa fertilizer applications in this same year gave yield increases of 2·3 and 1·0 bushels respectively.

At Hafford in the black soil zone a thirteen-year average yield of 15·6 bushels per acre was recorded on the check plots in comparison with 16·3 bushels from 25 pounds of 11–48–0, 17·0 bushels from farm manure, and 18·3 bushels from a combination of 11–48–0 and farm manure. At Parkside on grey black soil through twelve years 11–48–0 gave an average increase of 1·0 bushels over the check. Farmyard manure through the same period gave an average yield of 25·3 bushels per acre representing an increase of 6·3 bushels over the check plot which received neither manure nor chemical fertilizer.

In southeastern Saskatchewan results from twelve years work at Alameda give an average increase of 3·4 bushels per acre from an application of 25 pounds per acre of 11–48–0. At Arcola results through seven years give an increase of 2·0 bushels from the same fertilizer treatment. A summary of fourteen years work on the District Experiment Substation farm at Radville, on the "Trossachs Burn-Outs", records a decrease in yield due to fertilizer, of minus 0·5 bushel per acre. At Strasbourg on Weyburn light loam an average yield increase of 4·4 bushels was recorded through twelve years from 11–48–0 at 25 pounds per acre and at Yorkton through nine years an increase of 1·8 bushels was recorded from the same treatment on Canora silty clay loam.

In Manitoba fertilizer work on transitional grey-black soil at Lenswood in 1946 and 1947 gave average increase of 1·2 bushels for 11–48–0 at 40 pounds per acre, 2·4 bushels for 9–27–9 at 40 pounds plus 40 pounds of muriate of potash, and 2·6 bushels for an application of rotted farmyard manure at 10 tons per acre. Sulphate of ammonia and triple superphosphate at 40 pounds per acre respectively recorded decreases in yield of 1·4 and 1·8 bushels per acre.

TESTING CEREAL VARIETIES AND STRAINS AS TO REGIONAL ADAPTATION

Regional variety and verification tests comparing new selections of wheat, oats, barley and flax, with those commonly grown, have been undertaken on the Illustration Stations and District Experiment Substation farms in each of the provinces. These tests have been conducted in co-operation with the Cereal Division and represent an expansion of the work under way on the Central Experimental Farm at Ottawa and on the branch Experimental Farms and Stations across the Dominion. In this way it has been possible to evaluate the adaptation of new strains and to establish the zones in which they might be most advantageously grown.

The spring wheat tests have included such varieties as Redman, Regent, Rescue, Saunders, Thatcher, Apex 2156, Apex 1789, Marquis E32, Red Bobs, Red Bobs 222, Canus. Hybrid selections of oats have been compared with such varieties as Ajax, Abegweit, Vanguard, Erban, Roxton, Beacon, Banner, Victory, Exeter, Mabel, Garry, Clinton, Fortune, Eagle, Larain, and Legacy. The barley varieties Titan, Glacier, Campana, Trebi, Newal, Prospect, and Vantage, were studied from a feed and malting standpoint. Of the oil flax varieties, Rocket, Bison, Victory, Royal, Viking, and Dakota and flax for fibre varieties J.W.S., Liral Dominion, Stormont Cirrus and Stormont Gossamer, were under comparative test with hybrid strains. In sawfly-infested areas of the Prairie Provinces, a contribution has been made to the testing of resistant hybrids which have resulted in the development and licensing of such varieties as Rescue. A concentrated program of testing on the station farms in the northern regions under the direction of the Cereal Division was an important factor in obtaining data which resulted in the naming and licensing of Saunders wheat.

Varieties which have proved superior for 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 being operated. During the period 1938–1947 inclusive distribution by sale of improved varieties of cereals from station farms totalled 600,127 bushels. These sales were largely comprised of such varieties as Rescue, Thatcher, and Redman wheat; Ajax, Beaver and Vanguard oats and Titan barley. The number of farmers purchasing seed from the station operators during the ten-year period totalled 14,991.

FIG. 13. Rod-row tests of cereals on station farms provide valuable information on the adaptation of new varieties and strains. (Upper): An extensive series of plots of wheat, oats, barley and flax at Alameda, Sask., 1947. (Lower): Neighbouring farmers examine the cereal test plots on the Parkside, Sask., Illustration Station, 1944.

CEREAL COVER CROPS FOR SOIL DRIFT CONTROL AND PASTURE

Cover crops were seeded on the present District Experiment Substation at Claresholm and the Illustration Station farm formerly operated at Macleod in the area immediately east of the Rocky Mountain foothills as early as 1917. In this case the original objective in seeding a spring cereal in early fall was to provide protection against soil drifting. The use of such a crop for fall and winter pasture has been a secondary but important development. It was not until 1937 that its use for large-scale pasturing of feeder cattle was introduced.

Methods of seeding and the suitability of the various cereals have been tested at the Claresholm substation. Based on these tests the recommended method is to seed oats on fallow with an ordinary grain drill at three-quarters to one bushel per acre about the end of July. A preliminary test comparing oat varieties indicates that none were found superior to Victory for the purpose.

Tests on a large number of substation farms have shown that in those parts of the prairies where rainfall is definitely the limiting factor in crop production, this method of protecting summerfallows is not advisable. Dry soil previous to seeding has resulted in poor stands, and in many years further thinning was caused by grasshoppers. When a satisfactory stand has been obtained on these soils, a reduction in the yield of wheat the following year was suffered. In the Claresholm district it is very seldom that stands have not been secured, and in most years there has been no detrimental effect on the following wheat crop. Under the conditions commonly prevailing in this district the moisture used to produce the cover crop is usually replaced before spring seeding.

In the earlier years farmers turned livestock on this oat pasture but no large-scale commercial pasturing was attempted prior to 1937. In that year the operator of the Claresholm Substation arranged with cattle dealers in Calgary to pasture 2,700 head of feeder cattle on the local cover crop. This enterprise has grown to the point where it is estimated that over 45,000 acres of summerfallow are seeded to oats every fall and in favourable years up to 12,000 head of feeder cattle are shipped in for pasturing. The cattle are turned into the cover crop as soon as the grain strips have been combined. At this time there is usually 12 to 18 inches of growth and one acre of such a stand will provide feed for a full grown steer for from 4 to 5 weeks. Marketing is done early in the new year and approximately 75 per cent of the stock are shipped in a finished condition.

During each of the four years 1944 to 1947 inclusive studies have been conducted at Claresholm on rates of gain made by steers on cover crop pasture. It has been found that weather conditions have a profound effect on the daily rate of gain and the total weight put on during the pasture period. Steers at the Claresholm substation gained 2·8 pounds per day in 1944. However under adverse weather conditions in 1945 and 1946 daily gains of only 1·1 and 1·2 pounds respectively were recorded. In these two seasons, the most unfavourable since large-scale pasturing was undertaken, heavy snows remained on the ground for long periods. In the pasturing season of 1947, steers were placed on cover crop on October 22. On December 1, 140 head had gained an average of 2·95 pounds per day. Stormy weather followed and when 91 head of cattle were marketed on February 2 the average daily gain had dropped to 1·82 pounds.

Cover cropping is now a recommended practice in the area adjacent to the foothills. At Pincher Creek and Drumheller oats are frequently seeded on fallows in the fall. In the main, however, the Claresholm district is considered the centre of this farming practice which has assisted greatly in controlling soil drifting and at the same time has proved to be profitable in most years to farmers and cattlemen.

PASTURE INVESTIGATIONAL STUDIES

The improvement of permanent pastures by the application of chemical fertilizers has been an active project on Illustration Stations in the five Eastern Provinces and British Columbia since 1932. The data presented in this report were gathered through the years 1942 to 1947 inclusive, and represent the results of 458 tests. On each of the stations where permanent pastures are of practical importance an experiment was laid down to study the relative values of phosphorus, phosphorus plus potash, and a complete fertilizer in the maintenance of pasture yields. The data derived from these tests are presented in Table 5.

From the above it may be noted that all fertilizer treatments applied have given substantial yield increases. On the average of 458 tests the fertilizer element phosphorus has given a yield increase of 3·03 tons of green herbage per acre over the unfertilized check area. The addition of 120 lb. of muriate of

TABLE 5.—YIELD OF PASTURE HERBAGE IN TONS PER ACRE GREEN WEIGHT AS RECORDED FROM AREAS TREATED WITH VARIOUS FERTILIZER FORMULAE IN SIX CANADIAN PROVINCES 1942 TO 1947 INCLUSIVE

Province	Number of Tests	Treatment and yield per acre (Green weight)			
		Check	600 lb. Super-phosphate every 3 years	600 lb. Super-phosphate 120 lb. Muriate of potash every 3 years	600 lb. Super-phosphate + 120 lb. Muriate of potash every 3 years + 100 lb. Ammonium sulphate annually
		ton	ton	ton	ton
Prince Edward Island	50	3·80	6·32	6·90	8·55
Nova Scotia	55	5·10	10·39	11·02	11·66
New Brunswick	49	3·48	5·66	5·85	6·23
Quebec	202	5·39	8·10	9·05	9·90
Ontario	76	4·73	7·07	8·34	9·21
British Columbia	26	7·46	12·80	12·96	14·59
Average	458	4·99	8·02	8·81	9·72

potash per acre to the superphosphate has further increased the yield by 0·79 tons, and an annual treatment of 100 lb. of ammonium sulphate per acre has given an additional yield increase of 0·91 tons per acre. Besides increasing the yield of pasture herbage it was noted that fertilizer had a pronounced effect on the quality of herbage as measured by the species present. The greatest percentage of clover was found in the plot receiving phosphorus and potash; while weeds were most plentiful in the unfertilized check areas.

While the influence of fertilizer on the yield and quality of pasture herbage is quite general, considerable difference occurs between various pastures. At some locations the influence of any one nutrient may be much more, or less, pronounced than is indicated by the over-all average figures. On the basis of provincial averages it was found that nitrogen gave a yield increase of 1·63 and 1·65 tons per acre in British Columbia and Prince Edward Island respectively, while in New Brunswick it gave an increase of 0·38 tons per acre. New Brunswick and British Columbia pastures gave the least response to potash, the yield increase being 0·19 and 0·16 tons per acre respectively, while in Ontario an increase of 1·27 tons per acre was recorded. Phosphorus gave substantial yield increases in each province with a particularly favourable response in Nova Scotia and British Columbia. This variation in results also occurs within provinces between various station farms. An illustration of this variation is found in Ontario where most of the response to potash indicated in the provincial average is due to the results obtained on the more northerly stations and those on the lighter soils of the eastern section of the province. These local variations are caused by the species of herbage, soil type, local weather conditions, and other factors governing crop production.

This pasture experiment includes a comparison of the value of the practice of making annual applications of chemical fertilizer with that of applying the fertilizer every three years. These treatments are based on a 0–12–6 formula, one plot receiving 1,000 pounds per acre annually, another 333·5 pounds annually and a third plot receives 1,000 pounds per acre at the beginning of each three-year period. Each of these plots receives a supplemental treatment of 100 pounds of ammonium sulphate annually. From the results of this experiment annual applications of chemical fertilizer have not proved economical. On the average of 280 tests the plot receiving 1,000 pounds of 0–12–6 per year gave an increased yield of only 0·76 tons per acre in comparison with the plot receiving the 1,000 pound per acre application of the same fertilizer at intervals of three years. No advantage has been derived from the lighter annual appli-

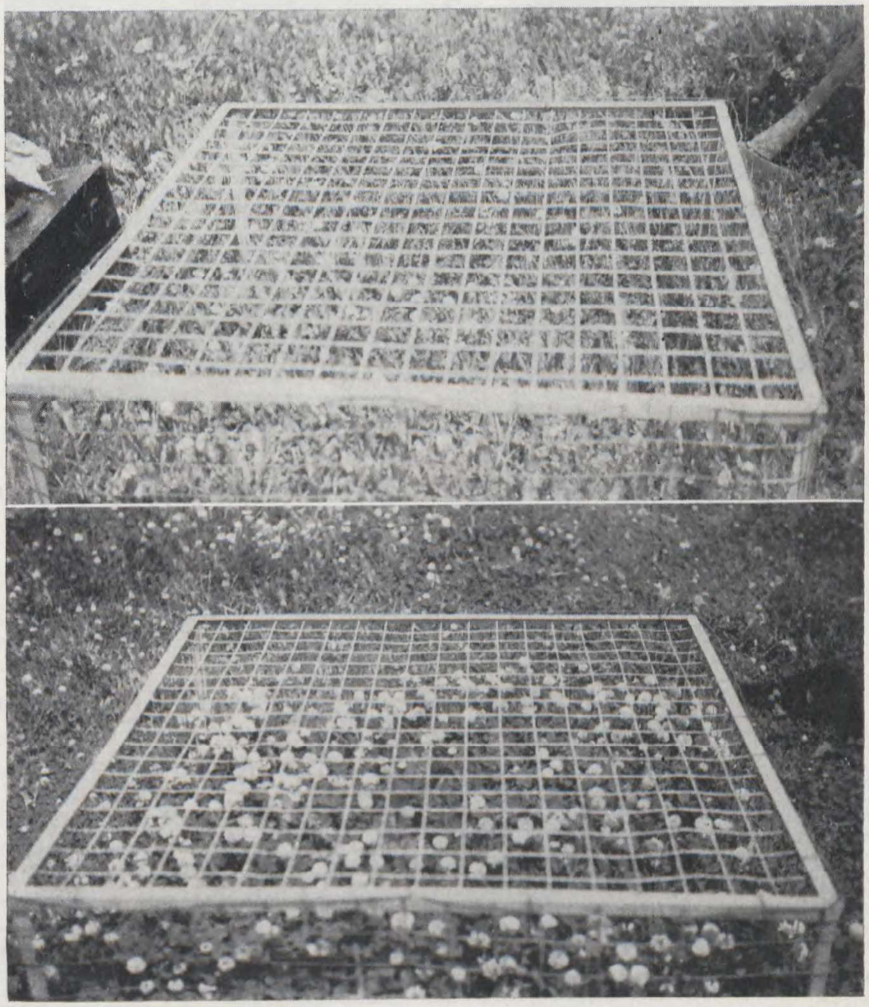


Fig. 14.—Pasture pens on the pasture experiment at Caledonia Springs, Ontario, 1943. (Upper): Check-no fertilizer-treatment. (Lower): An application of 600 pounds per acre of superphosphate 20 per cent was made on this plot every three years. Through four years this treatment gave an average increase over the check of 5·03 tons of green herbage per acre. Note the high proportion of white clover in the fertilized sward.

cation of 333·5 pounds per acre, the average recorded yield being lower by 0·46 ton than that on the plots receiving 1,000 pounds per acre at the beginning of each three-year period.

In some areas where pasture sods are thin and worn out it was found that surface applications of fertilizer and limestone gave little response. Accordingly an experiment was laid down at the Hampstead station in New Brunswick in 1941 with eight methods of rejuvenating old sod being compared. This test included ploughing, springtooth harrowing, reseeding, liming and fertilizing.

FIG. 15.—Cattle grazing on fertilized pasture on the Caledonia Springs, Ontario, Illustration Station in 1943. This plot received 600 pounds of superphosphate every 3 years.

The treatments compared and the results derived from this experiment through the five-year period 1942–1946 inclusive are summarized in Table 6.

TABLE 6.—METHODS OF REJUVENATING OLD PASTURE SODS HAMPSTEAD ILLUSTRATION STATION, NEW BRUNSWICK 1942 TO 1946 INCLUSIVE

Treatment per acre*	Average Yield Per Acre Green Herbage 1942–46	Composition of Herbage		
		Clover	Grass	Weeds
	tons	%	%	%
1. Plough and reseed, manure 10 tons + fertilizer	7·88	42	45	13
2. Plough and reseed, Manure 10 tons + 1 ton limestone + fertilizer	8·47	39	48	13
3. Plough and reseed, 1 ton limestone + fertilizer	8·26	40	51	9
4. Harrow sod 1 ton limestone + fertilizer	6·69	40	54	6
5. Harrow and reseed, 1 ton limestone + fertilizer	7·90	48	44	8
6. Harrow and reseed + fertilizer	5·10	42	49	9
7. Surface application of fertilizer	4·25	32	54	14
8. Surface application of 1 ton limestone no fertilizer	1·72	27	58	15
9. Check	1·26	4	67	29

* Where applied, fertilizer treatments per acre were identical on each plot as follows: 1941—300 lb 5-10-5; 1942, 43, and 44, 140 lb. superphosphate plus 50 lb. muriate of potash; 1945 and 1946—300 lb. 4-12-6.

A review of the data in Table 6 shows that through the five years of the experiment the surface application of either lime or chemical fertilizer without tillage has given less effective returns. Where reseeding was done yields were increased substantially. The proportion of weeds in the pasture was reduced by liming and fertilization and a further improvement in the composition of the herbage was achieved by reseeding. The highest yield in the experiment was on plot 2 which was ploughed, reseeded and treated with manure, limestone and chemical fertilizers. While treatment with farm manure has given certain increases in yield the treatment on plot 3 appears to be the most promising. Unless considerable surplus of manure is available it is usually applied to greater advantage on other crops rather than on pasture.

CONTROL OF BROWN-HEART IN SWEDES

The control of brown-heart in swedes by the application of borax has been studied under the conditions prevailing on a number of Illustration Stations since 1926. Tests have been conducted on several soil types in the five Eastern Provinces and British Columbia. The basis of these tests is a comparison of the effect of applying twenty pounds of powdered borax per acre prior to seeding the swedes, and of leaving an adjacent area on which no borax was included in the treatments. At harvest time one hundred swedes from both the treated and untreated areas of each test were cut and examined for brown-heart incidence. The results of these investigations are presented in Table 7 and represent a summary of 433 tests.

TABLE 7.—THE EFFECT OF BORAX IN THE CONTROL OF BROWN-HEART IN SWEDES—EASTERN PROVINCES 1938 TO 1947

Province	Number of tests	Borax			No Borax		
		Free	Slight	Severe	Free	Slight	Severe
		%	%	%	%	%	%
Prince Edward Island	47	91·8	3·7	4·5	54·5	10·5	35·0
Nova Scotia	89	94·0	3·2	2·8	60·7	10·0	29·3
New Brunswick	55	88·1	7·0	4·9	50·1	17·8	32·1
Quebec	208	89·2	7·9	2·9	63·9	21·8	14·3
Ontario	31	81·9	12·0	6·1	7·3	54·4	38·3
Average	433	89·9	6·6	3·5	59·4	15·4	25·2

It will be observed from the above table that the application of borax to the soil is a very effective method of controlling brown-heart. On the average of 433 tests 89·9 per cent of the swedes grown where borax has been used were free of brown-heart. On only six of the stations, where the test has been conducted, is there over 20 per cent of the crop affected on the areas treated with borax. Five of these are in Quebec and one in New Brunswick. One very unique case is the station at St. Evariste, Quebec, where over 90 per cent of the crop was affected regardless of borax applications. In cases such as this some other method of control, such as the spraying of borax on the foliage, must be employed.

POTATO PRODUCTION STUDIES

Extensive investigations have been conducted on the potato crop on Illustration Station farms throughout the five Eastern Provinces and British Columbia. The general importance of this crop due to the fact that it is grown on almost every farm has necessitated this detailed study of the potato growing enterprise. Experimental projects have, therefore, been directed to such broad problems as:—

1. Fertility Studies.
2. Crop sequence and Cover Crops.
3. Seed Production and Disease Control.

In view of the wide range of adaptation peculiar to this crop the data presented in this report relate particularly to work that has been conducted in the more specialized potato areas.

Potato Fertility Studies

Fertility work on the potato crop has been based on the determination of suitable formulae, rates of application and the value of farm manure for the maintenance and increase of yields. Extensive experiments have been conducted at Hall's Harbour, Nova Scotia; East Centreville, New Brunswick; Peribonca and Luceville in Quebec, and at Fort William, Ontario.

At Hall's Harbour chemical fertilizer was applied at the rate of 2,000 pounds per acre in all possible combinations of nitrogen at 2·5 and 5 per cent, phosphorus at 5, 10, and 20 per cent, and potash at 0, 5 and 10 per cent. The yields recorded on this test through five years show that nitrogen at 2·5 per cent was fully as effective as 5 per cent. Response to phosphorus was quite strong and the high rate of 20 per cent was effective when combined with appropriate levels of nitrogen and potash. In the main there was little significance from rates of potash above 5 per cent. The formula 5–20–5 produced the highest yield of 367·0 bushels per acre while 5–20–10 at the same rate of 2,000 pounds per acre, gave a slightly lower yield of 356 bushels. A study of all the data derived from this experiment indicates that on this medium loam soil, a chemical fertilizer high in phosphoric acid comparatively low in nitrogen and potash is the one productive of the highest yield with the greatest economy.

The experiment at East Centreville in New Brunswick on sandy loam soil "Caribou Loam" sought to determine the value of nitrogen at 4 per cent in combination with phosphorus at 4, 8, and 12 per cent; and potash at 5, 10 and 15 per cent respectively with and without farm manure. Chemical fertilizers

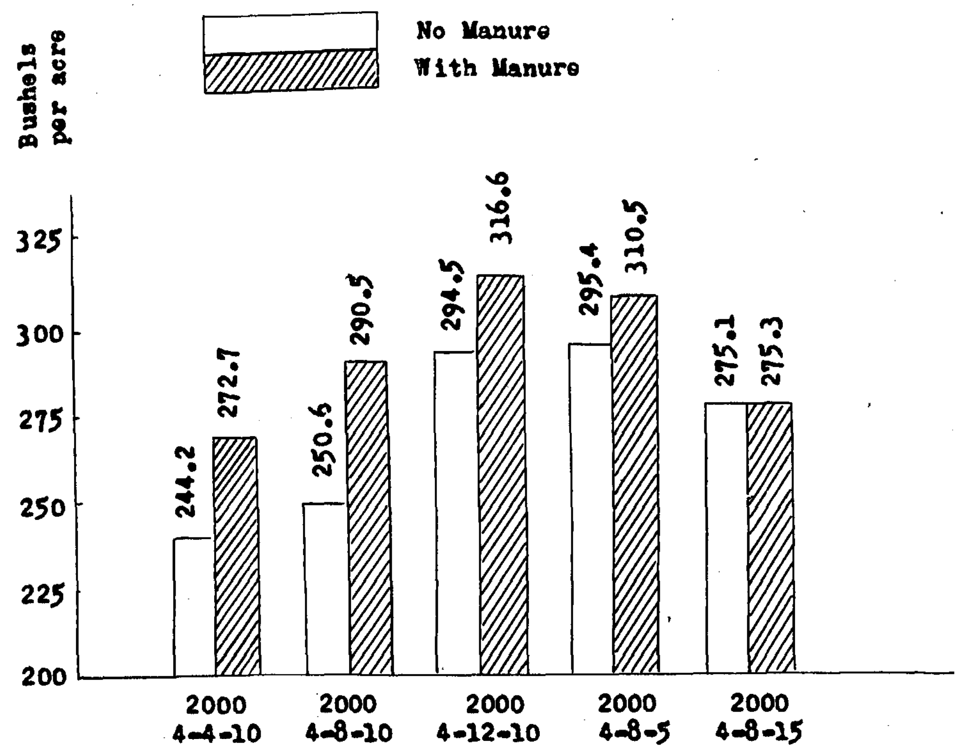


Fig. 16.—Average Results: Fertilizer formulae test with potatoes. East Centreville Illustration Station, 1945–1947.

were applied to all plots at a uniform rate of 2,000 pounds per acre and farm manure was applied at 10 tons per acre to those plots receiving manurial treatment. The average yields recorded through the three-year period 1945–1947 inclusive are presented in Figure 16.

A review of Figure 16 shows that manure was effective in increasing potato yields except where potash was applied in the heavy ratio of 15 per cent in combination with nitrogen at 4 per cent and phosphorus at 8 per cent. The average increase recorded from manurial application on all plots was 21·2 bushels per acre. The 12 per cent level of phosphorus was most effective but the lowest or 5 per cent level of potash supplied the requirement for commercial potato production on this soil.

Combined with this test was a separate study dealing with 4–8–10 fertilizer applied at rates of 1,000, 1,500, 2,000, and 2,500 pounds per acre with and without manure at 10 tons per acre. The initial application of 1,000 pounds per acre gave an increase in yield of 72·7 bushels without manure and 56·4 bushels when applied as a supplement to the basal application of manure at 10 tons per acre. Higher rates of application of 4–8–10 fertilizer were scarcely justified by corresponding potato yields although progressively higher yields were recorded for the heavier rates but the extra 1,500 pound application at the 2,500 pound level only gave a net increase of 33·0 bushels where no manure was used and 47·0 bushels where in combination with farm manure. In general these experiments at East Centreville have emphasized the value of manure as a source of organic matter and plant food for the potato crop.

FIG. 17.—A field of potatoes on the Illustration Station at Montague, P.E.I.

Experimental work at Peribonca in the Lake St. John District of Quebec was first instituted in 1940. The prevailing soil type in the area is sandy loam deficient in organic matter. The average data from eight years show that, when compared with a check area receiving neither manure nor chemical fertilizer, manure at 8, 16, and 24 tons per acre increased potato yields by 103·6, 122·3, and 157·3 bushels per acre respectively. Manure at 8 tons per acre was supplemented with chemical fertilizer at 600 pounds per acre containing varying levels of nitrogen, phosphorus and potash. The levels or formulae tested in this experiment are as follows:

0–8–0	4–12–6
0–16–0	4–8–0
0–0–10	4–8–5
0–0–20	4–8–10
0–8–10	4–8–15
2–12–6	4–8–20
2–12–10	4–16–10
4–0–10	4–20–10
4–4–10	8–8–10
4–12–10	12–8–10

In this experiment manure at 8 tons per acre recorded an average yield of 377·4 bushels through eight years. Progressively higher levels of nitrogen gave increases in yields of 82·2 bushels per acre at 4 per cent; 84·0 bushels at 8 per cent and 103·5 bushels per acre at 12 per cent. Phosphorus and potash gave no significant increase in yields beyond the 8 and 10 per cent levels, the average increased yields in each case being 82·2 bushels. Study of the complete data through eight years indicates that where manure is in short supply higher levels of nitrogen are required. If manure is available in sufficient quantity to apply on the potato land at 16 tons per acre a chemical fertilizer supplement of 600 pounds of 4–8–10 per acre gives effective results. A similar experiment was laid down at Luceville on sandy soil in 1947. Results from the first year of work on this station are quite similar to those at Peribonca although higher levels of phosphorus appear to be required.

In Ontario four distinct projects dealing with fertility problems in potato production have been conducted on the District Experiment Substation at Fort William. The experiment of longest standing has been conducted through a period of nine years. In this experiment manure and superphosphate were applied alone and in combination and compared to applications of 4–8–10 fertilizer without manure. Average yields per acre recorded through the nine-year period that this experiment was conducted are summarized in Table 8.

TABLE 8.—MANURE AND CHEMICAL FERTILIZERS ON POTATOES
FORT WILLIAM, ONT., 1938–1947

Treatment per acre	Yield per acre
	bu.
Manure 16 tons	210·0
Manure 16 tons + 500 lb. Superphosphate 20%	259·4
500 lb. Superphosphate 20%	155·5
250 lb. 4–8–10	148·8
500 lb. 4–8–10	162·5
1,000 lb. 4–8–10	199·1
Check	131·3

A review of the data in this table indicates that farm manure and superphosphate have been the most important fertilizer materials. In regard to manure the 16 tons per acre application was slightly superior to an application of 1,000 pounds per acre of 4–8–10 fertilizer. Comparisons made between muriate of potash and sulphate of potash as sources of K_2O in this same experiment resulted in the sulphate form producing an average increase of 9·0 bushels per acre over the muriate form. Results derived from a chemical formula test conducted in the years 1942, 1944 and 1945 indicated that when no manure was available chemical fertilizers containing nitrogen, phosphorus and potash in the ratio of 1–8–5 respectively would be effective for potato production on this sandy loam soil.

Experimental work on the potato crop has been conducted on the Illustration Stations at Alberni, Courtenay, Duncan and Revelstoke in British Columbia. The treatments were identical at all four stations with manure being applied alone at 16 tons per acre and compared with the same manurial treatment supplemented by 2–16–6 fertilizer at rates of 250, 500 and 800 pounds per acre. Agricultural limestone was applied to certain plots at the rate of 2 tons per acre. Manure alone recorded an average yield of 131·7 bushels per acre. Where manure was supplemented with 250, 500 and 800 pounds per acre of 2–16–6 fertilizer the respective yields recorded were 172·0, 204·7 and 212·3 bushels per acre. In the main the 500-pound application was considered to be the most effective. Limestone made no contribution to yields but did increase the incidence of scabbed tubers.

Crop Sequence Studies and Green Manuring Crops for Potatoes

The limited livestock program on most specialized potato farms with the ensuing shortage of farm manure creates a problem in the maintenance of organic matter. Experimental work on the Illustration Stations at Hall's Harbour, Nova Scotia, and at Peribonca and Luceville in Quebec permits an evaluation of various types of green manuring crops and the effect of long and short term rotations on the yield of the potato crop.

In 1940 a series of experiments was undertaken at Hall's Harbour. The crop sequences and cover crop studies instituted were as follows:

(1) Continuous potatoes plus a cover crop of fall rye.

(2) Two-year sequence of potatoes and a green manuring crop of one of the following: soybeans, rape, seradella, lupins, buckwheat.

(3) Three-year rotation: potatoes, oats, clover hay.

(4) Four-year rotation: potatoes, oats, clover hay, timothy hay.

In all cases the potato crop received a uniform application of 2,000 pounds per acre of 5–10–5 chemical fertilizer. Results from eight years work show that soybeans, rape and seradella did not produce enough plant material to be of appreciable value as sources of organic matter. Blue lupins were of some value but buckwheat was the most useful of the crops tested. Fall rye sown in the autumn following harvesting of the potatoes did not produce enough growth to be of any value. In the three- and four-year crop sequences it was found that growth of hay in the third and fourth years following fertilization for potatoes was not sufficient to produce enough aftermath to provide a potential source of organic matter.

At Peribonca and Luceville in Quebec results of similar experiments showed that the two most valuable crops as green manure were red clover and vetch. The procedure of ploughing down the aftermath of red clover had the greatest merit as this practice gave the most sustained potato yields and involved less labour than ploughing, seeding and subsequently ploughing down a crop of vetch. At these two points the first cutting of hay was valuable as fodder which, when fed to livestock provided a source of farm manure. Where moisture conditions are such that a favourable growth of aftermath is produced this is a recommended practice.

Seed Production and Disease Control

Varietal adaptation studies are conducted on a large number of Illustration Stations in the more specialized potato districts. In Prince Edward Island a program of eye-indexing is conducted to ensure that operators of station farms are planting and making available to neighbouring farms the very highest quality of certified seed. In New Brunswick the operators of the Currieburg and East Centreville Illustration Stations specialize in the production of Foundation and Certified seed of the Katahdin variety. The varieties Green Mountain and Irish Cobblers are widely grown on Illustration Stations in view of their high quality although somewhat susceptible to disease particularly late blight and leaf roll. Through four years on the District Experiment Substation at Fort William in Ontario, Green Mountains have consistently outyielded Sequoia, Houma, Irish Cobbler, Warba, Chippewa, Netted Gem, Sebago and Katahdin. The variety Earlaine is under observation and test on the substations in southwestern Saskatchewan. This variety is thought to have some adaptation to dry land areas. Early Ohio, Canus, Netted Gem, Irish Cobbler, Warba, Golden Russett and Bliss Triumph are some of the more important varieties being grown and under observation on station farms in the Prairie Provinces. The effect of a well organized spray program indicates the benefits that can be expected from such a practice. Through four years at Fort William an average yield of 329·4 bushels per acre was recorded on the sprayed plot in comparison with 222·9 bushels on the plot which received no fungicidal treatment. The proportion of marketable tubers was 91·1 per cent on the sprayed plot and 77·1 per cent on the plot which received no treatment.

Fig. 18.—Spraying the Experimental Potato Plots on the Fort William Substation, 1947.

The maintenance of high quality seed stocks of potatoes on stations has been accomplished by means of a definite program of tuber unit seed production to provide Foundation seed for planting on the main fields. On all stations where commercial production of certified seed potatoes is an active project the growing of a seed plot under the tuber unit method is a standard practice. Sales of certified seed potatoes by operators of Illustration Stations to farmers in surrounding districts totalled 60,547 bushels during the ten-year period 1938 to 1947 inclusive. Of this total operators in New Brunswick distributed 12,971 bushels. The results of the introduction of improved varieties and cultural practices are shown by records on the Fournier Illustration Station in Ontario. Following the initial introduction of 15 bushels of certified seed of Green Mountains in 1938 this operator has produced and distributed by sale more than 3,000 bushels of certified seed to neighbouring farmers during the ten-year period under review.

FIBRE FLAX PRODUCTION

With the declaration of war in 1939 flax became an important crop due to the demand for fibre in the manufacture of military supplies and equipment. In eastern Ontario and in the province of Quebec acreage seeded to this crop was greatly expanded and many co-operatives were formed and processing mills erected. The Illustration Stations at L'Acadie, Maskinongé, St. Constant and St. Simon are located in areas which become important centres of fibre flax production. In 1940 variety tests were instituted in co-operation with the Fibre Division, Central Experimental Farm, Ottawa. In the initial experiments the varieties J.W.S., Liral Dominion, Stormont Cirrus and Stormont Gossamer were tested and compared. The varieties Stormont Cirrus and Liral Dominion proved to be superior for the production of line fibre and tow. The variety J.W.S. was distinctly inferior and in 1944 was replaced by the variety Liral Prince which was imported from Ireland by the Fibre Division. This variety has outyielded Stormont Cirrus, Stormont Gossamer and Liral Dominion by 36·3 pounds per acre of line fibre. In 1947, L26 a new strain of Stormont Gossamer was included in the tests and is showing promise.

FIG. 19.—Pulling fibre flax with a Canadian-built machine on the L'Acadie Illustration Station, 1947.

Fertilizer studies with flax have been conducted through two years on the stations at Maskinongé and St. Constant. The treatments compared and the average results derived from these experiments are summarized in Table 9.

From the results of this experiment mixed fertilizers have given moderate increases in yields when compared with the check plots which received no treatment. The formula 2–12–6 at 500 pounds per acre was as effective in maintaining yields as either 2–12–10 or 4–8–10 applied at the same rate. Superphosphate and muriate of potash applied singly at 300 and 100 pounds per acre respectively did not give any appreciable increase in yield of total fibre. Ammonium nitrate at 100 pounds per acre gave a net increase in yield of 81·2 pounds of total fibre,

TABLE 9.—THE EFFECT OF CHEMICAL FERTILIZERS ON THE YIELD OF FIBRE FLAX AT MASKINONGÉ AND ST. CONSTANT QUE. 1946 AND 1947

Treatment per acre	Yield per acre			
	Line Fibre	Tow	Total Fibre	Seed
	lb.	lb.	lb.	bu.
500 lb. 2–12–10	166·7	170·8	337·5	4·53
500 lb. 2–12–6	181·2	185·4	366·6	5·03
500 lb. 4–8–10	170·8	170·8	341·6	5·18
100 lb. Ammonium nitrate	195·8	187·5	383·3	5·61
300 lb. Superphosphate (20% P_2O_5)	156·2	154·1	310·3	4·51
100 lb. Muriate of potash (50% K_2O)	162·5	152·1	314·5	4·29
Check (no treatment)	150·0	152·1	302·1	4·12

however its main value seems to be that it stimulates early growth when soil conditions may be somewhat unfavourable in the spring. Under normal conditions where flax is grown on heavy soils as a general farm crop in the rotation, fertility practices which are required for other field crops appear to give satisfactory results.

HOP GROWING

An Illustration Station was established at Fournier, Ont. in 1937 to study problems incidental to hop production. Four distinct phases of production namely: fertilizer requirements, pole training vs. wire trellis, insect control and disease control were studied. The soil type on the station and in the area is sand loam, well drained and quite suitable for hop production.

Fertility Investigations

Studies with fertilizers on hops were established at Fournier in 1937 and a continuous program of investigation has been carried on through the subsequent ten-year period. The original experiment laid out in factorial design and duplicated compared the effect of nitrogen, phosphorus and potash and lime singly and in combination on the yield of this crop. Manure was applied to all plots at the rate of 20 tons per acre, the basis for chemical fertilizer treatment was 750 pounds per acre of 4–8–10 formula, with lime being applied to prescribed plots at the rate of 1 ton per acre. Manurial treatments and fertilizer applications were made annually throughout the course of the experiment. Yield data were taken through the four years 1937 to 1940 inclusive and in 1941 no fertilizers were applied but yields were taken to determine the residual effect of fertilizer treatment. In 1942 and 1943 a further experiment was devised to provide high levels of nitrogen. On some plots 30 pounds of nitrogen (N) was applied in the form of sulphate of ammonia in the spring and followed up at blossom time with an additional 13·2 pounds per acre which was supplied by a side dressing of 145 pounds of nitrate of soda.

The results from the original experiment conducted during the period 1937 to 1940 inclusive showed strong significance for applications of nitrogen. When nitrogen levels were increased in the revised experiment it was found that the plots receiving the double treatment of this element appeared to suffer from winter injury and the proportion of soft or rotted crowns was greater on these areas. This condition was not so apparent where phosphorus and potash were included in the fertilizer treatment. No measurable response was received from applications of lime. The most suitable formula was found to be 4–8–10 chemical fertilizer. The average yield recorded from annual treatment with 4–8–10 at 750 pounds per acre was 1315·6 pounds of dried hops per acre in comparison to a check yield of 946·4 pounds. All plots received the same basal manurial application of 20 tons per acre. In terms of economic return at the prices prevailing this increase in yield represented an increase in revenue of from $143.98 to $276.90 per acre for an expenditure not exceeding twenty dollars ($20.00) in fertilizer.

In 1941 when yields were taken to determine the residual effect of fertilizer treatment, no benefits from fertilizers applied in 1940 were recorded. The practice of annual fertilization appears necessary to assure sustained production since the hop plant is a rapid grower and requires large amounts of readily available plant food in its vegetative stages. Further work with balanced fertilizers such as 4–8–10 formula in 1945, 1946 and 1947 shows that under the conditions encountered on this Fournier sand loam rates of application up to 1,000 pounds per acre give constantly increased returns. Above this amount the records from three years of experimental work indicate that it is doubtful if heavier applications will give yield increases of economic importance.

Pole Training vs. Trellis

The common method of training hops in Eastern Canada is to use poles. Two cedar poles 20 feet long and about 6 inches at the butts are planted in the row on each side of the hill. Three vines are trained on each pole. Training usually begins when the vines have made 2½ to 3 feet of growth. In British Columbia hops are usually trained on twine leading to an overhead wire trellis. A comparative test was established at Fournier in 1939 to evaluate the effectiveness of the two systems of training. In that year the trellissed yard outyielded

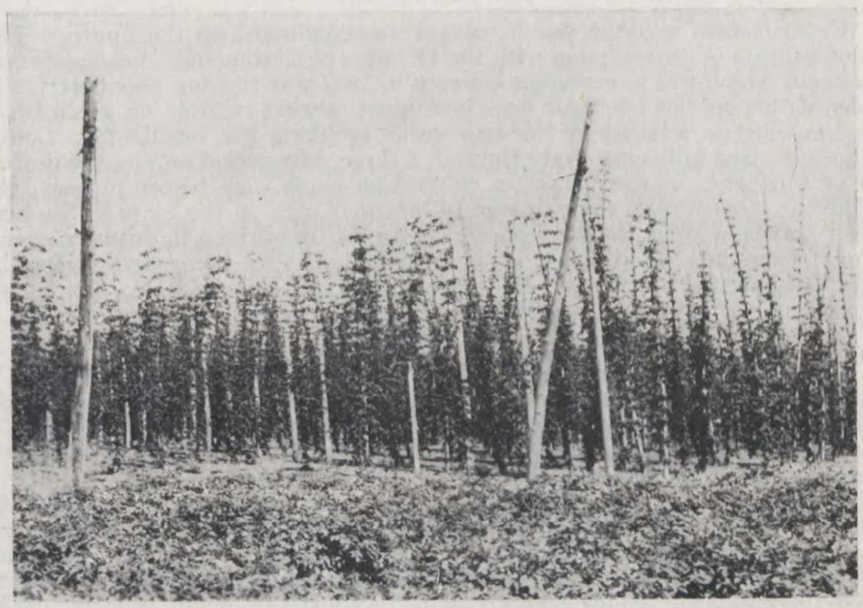


Fig. 20.—General view of Hop Yard, Fournier Illustration Station, July, 1944. Photo shows trellis area while pole-trained hops are at right.

the pole-trained yard by 296 pounds of dried hops per acre and in succeeding years the average increase in yield per acre on the trellissed area has been 40 pounds per acre. Usually, hops grown on trellis remain in production through a longer period of years due to the fact that the vines are left to dry while still attached to the roots not being cut at picking time as is the case with pole-trained hops. Considerable bleeding of the vines when cut relatively green on pole-trained yards can weaken the roots to the extent that they are more subject to winter-killing.

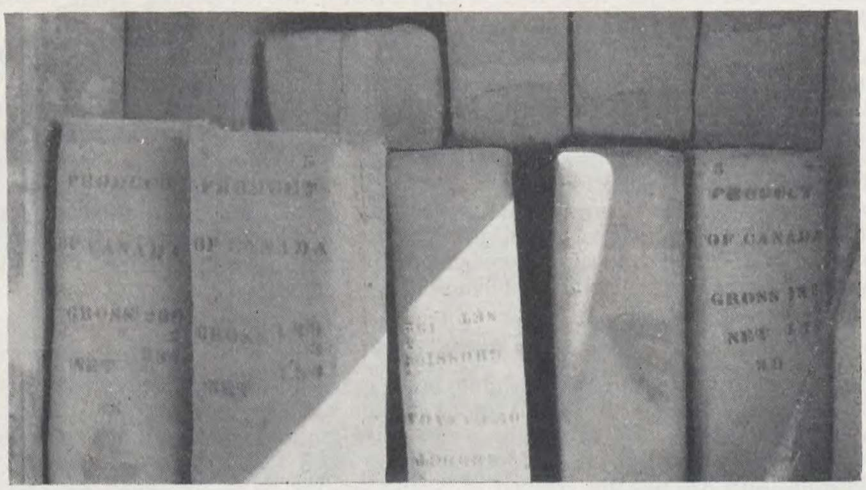


FIG. 20. (a)—Baled hops on car for export to United States.

INSECT CONTROL

Experimental work on insect control was conducted on the Fournier Illustration Station in co-operation with the Division of Entomology, Science Service. The insect which was of economic concern in 1937 was the hop vine borer. The moths of this species lay their eggs in August, almost entirely on green foxtail grass growing as a weed in the hop yards or along the headlands. Control methods devised following study through a three-year period require the destruction of this grass in the yards by cultivation some time before harvest, thus forcing the moths when they emerge to lay their eggs on the grass in the headlands. In these areas the eggs can be destroyed by burning in autumn or early spring. Complete information on control of hop vine borer, red spider, hop aphid and hop flea beetle can be obtained in Special Pamphlet No. 52, entitled "Hop Growing" or from the Division of Entomology, Science Service.

DISEASE CONTROL

Investigations on disease control with particular reference to downy mildew have been conducted on the Fournier Illustration Station by the Division of Botany and Plant Pathology, Science Service, in co-operation with this Division. Downy mildew first became serious in the Fournier hop area in 1943. Up to that time growers had depended entirely on fungicidal dusts, and for the most part used sulphur, for the control of all fungus diseases. Sulphur controlled powdery mildew but had no effect on downy mildew. "A spray experiment initiated in 1944 and conducted through 1947 demonstrated the value of bordeaux 10–10–100 and C.O.C.S. for general use in the control of downy mildew. It has been found that the addition of a spreader-adhesive to most spray material provides better coverage and longer protection with the results that increased yields are possible. The following spray schedule has been found to be suitable for this district: begin spraying about June 15 and repeat at 10 day intervals until the cones form about August 1. If powdery mildew is prevalent, dusting with sulphur may be necessary after the spraying has been discontinued. Observations made in the course of these tests indicate that spraying alone is not sufficient to control downy mildew. It must be accompanied by good cultural practices, including clean cultivation, early tying, and destruction of crop debris after harvest".[1]

TOBACCO PRODUCTION STUDIES

A special project dealing with problems in connection with the production of high quality cigar tobacco was established in 1945 in co-operation with the Experimental Station at L'Assomption, Quebec, on the Illustration Station farm at St. Jacques de Montcalm in that same province. The main experiment consists of a comparison of no manure versus manure at 5 and 10 tons per acre with all plots receiving additional treatments of 5–8–7 tobacco fertilizer at rates of 750 and 1,000 pounds per acre. The manure is applied on a clover aftermath and ploughed under in the fall. The chemical fertilizer is applied in bands on each side of the row when the seedlings are transplanted in the field. The crop is handled in the regular manner insofar as cultivation, topping, suckering and harvesting are concerned. The plants from each plot are kept in separate lots and cured yields are determined when packing for shipment. The results of this experiment are summarized in Table 10.

TABLE 10.—YIELDS OF CIGAR TOBACCO FROM FERTILIZER TEST AT ST. JACQUES QUE., 1945 TO 1947 INCLUSIVE

Treatment per acre	Yield per acre	Quality Index	Crop Index
	lb.	¢	$
No manure, 1,000 lb. 5–8–7	1614·7	22·4	361·37
No manure, 750 lb. 5–8–7	1609·7	21·5	341·77
Manure 5 tons + 1000 lb. 5–8–7	1717·0	21·2	359·31
Manure 5 tons + 750 lb. 5–8–7	1736·7	21·3	362·39
Manure 10 tons + 1,000 lb. 5–8–7	1583·3	20·8	325·69
Manure 10 tons + 750 lb. 5–8–7	1672·7	21·4	353·30

It will be observed that the most productive treatment through the three years has been where manure was applied at 5 tons per acre and supplemented with 750 pounds of 5–8–7 fertilizer. The three-year average yield on these plots was 1736·7 pounds per acre giving a gross return of $362·39. From the standpoint of fertility maintenance, favourable yields and sustained quality of product, this treatment is promising. It is possible that on soils lower in basic organic matter higher rates of manure might be required. Organic-matter content of the soil on these plots was 3·91 per cent at planting time and 3·87 per cent when the crop was harvested. On the plots receiving 1,000 pounds of 5–8–7 without manure chemical analyses at planting time showed an organic-matter content of 3·80 per cent while at harvest it had decreased to 3·64 per cent. This represented a reduction of 0·16 per cent in comparison with 0·04 per cent for the plots receiving manure at 5 tons and 750 pounds per acre of chemical fertilizers.

SUGAR BEETS

In 1946 experimental work was instituted on sugar beets on the Illustration Station farms at Maskinongé, St. Jacques and St. Simon in Quebec. These stations are located in the sugar beet producing area of the province and the investigations were undertaken as a part of a uniform plan to provide additional information on the cultivation of this crop. The basis for the experiment is the evaluation of three methods of seeding where ordinary seed, segmented seed and transplanted seedlings are compared. The only fertilizer treatment was a basal

[1] Excerpt from Experimental Report: L. T. Richardson, Plant Pathologist, Division of Botany and Plant Pathology, Science Service.

application of farm manure at 12 tons per acre. Yields of roots were recorded in tons per acre at harvest time and sample lots were taken and analysed for purity from the standpoint of foreign matter present and percentage sugar.

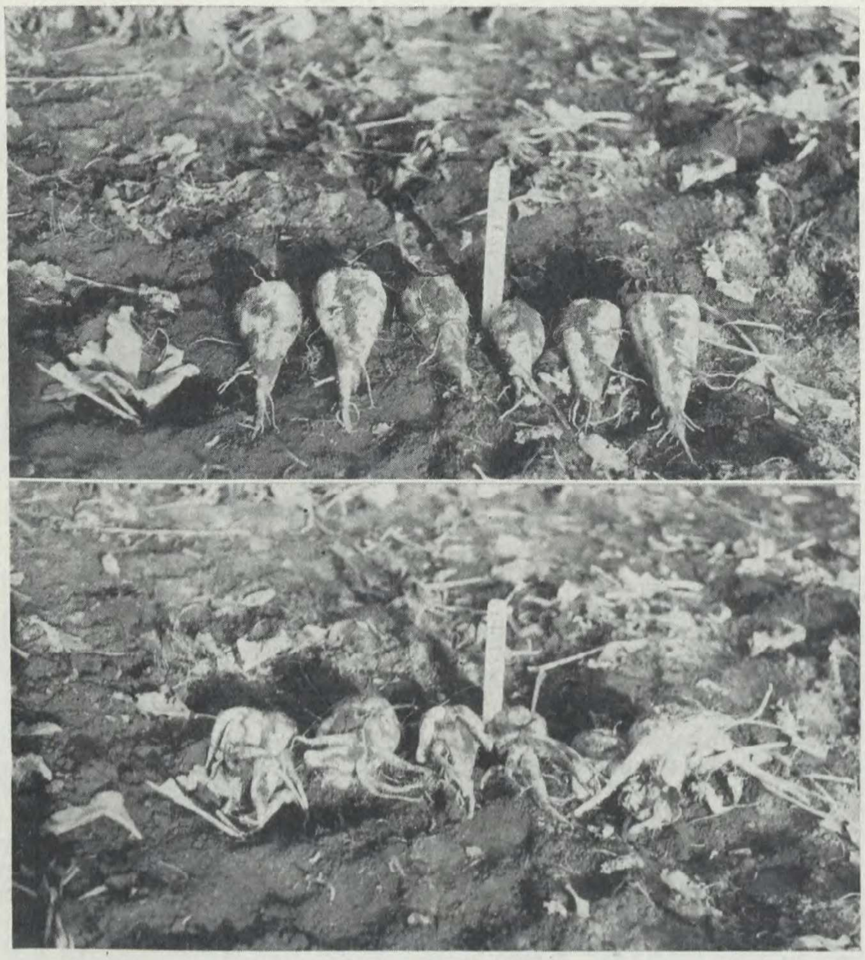


FIG. 21.—Sugar beets produced on the Illustration Station, St. Jacques, Que., 1947. (Upper): Roots from ordinary seed. (Lower): Roots produced by transplanted seedlings. Note the roughness and pronginess in comparison to the above. This type of root is not favoured for processing.

A summary of all tests conducted through 1946 and 1947 shows that ordinary seed yielded an average of 8·13 tons per acre containing 16·5 per cent sugar in comparison with segmented seed which recorded a yield of 7·68 tons per acre, 15·7 per cent sugar, and transplanted seedlings 15·85 tons per acre, 15·0 per cent sugar. In the main the higher yielding crops were slightly lower in sugar content. The amount of foreign matter was highest on the transplanted plots due to pronginess and the rougher shape of the roots. The piling and processing of these roots was more difficult and as a result sugar beets grown from transplanted seedlings were not favoured at the local sugar refinery. Segmented seed appeared to germinate more slowly than did ordinary seed while transplanted seedlings grew rapidly and were considerably in advance of the other plots at the normal date of thinning. Plantings with ordinary seed showed more vigour and were thicker in the row than those from segmented seed and thus required more time to complete thinning operations.

CRANBERRIES

Cranberries are native to many areas in the Eastern Provinces. Exports of this fruit from Prince Edward Island alone in 1946 amounted to 65,000 pounds valued at $20,000. As an auxiliary source of income on farms where suitable areas are available this crop can become a profitable sideline. Investigational work on cranberry production was instituted on the Illustration Stations at East Point, Prince Edward Island in 1937 and Cumberland Point, New Brunswick in 1941. Lines of work conducted have been the preparation of bogs for planting, maintenance in productivity of established bogs, varietal comparisons, weed, grass, and insect control.

Work on the stations in Prince Edward Island has dealt mainly with the production of cranberries on upland soils whereas at Cumberland Point operations were confined largely to the low bog type of plantation. At East Point, P.E.I., it has been found that fields with moderate to good stands may be rendered more productive with proper care. The first requisite with new plantations coming into production as well as established areas is to remove all tree and shrub growth. While burning is effective as a cleanup practice it should not be done when the ground is dry or injury may be sustained by the cranberry roots. When preparing new areas for planting the turf must be removed and sand applied to a depth of two inches or more. Subsequent sandings aid materially in promoting root formation, provide anchorage, ensure a well aerated layer of top soil favourable to plant development and discourage the growth of moss and other competitive plants.

Operations required for the establishment of plantations on low bog areas have been under study at Cumberland Point in New Brunswick. The land is a heavy clay loam with several pockets or basins in which decayed organic matter has accumulated to a depth of one inch to one foot and the subsoil is a stiff blue brick clay. Two-thirds of an acre was prepared for planting in May, 1942. In preliminary work a border ditch was dug around the area and an outlet opened into the adjacent lake. Coarse sand was hauled from the lake shore and spread evenly to a depth of three inches during the winter of 1941-42. A total of 618 man hours were required for initial preparatory work with sanding operations consuming 419 man hours and 65 team hours for the hauling and spreading of two hundred and forty-two loads of sand. The total cost of preparing the two-thirds acre bog for planting was $347.10.

Varieties

Disease-free vines of the varieties Early Black and Howes were planted at Cumberland Point in 1942. One third of an acre of each variety was set out. The yield in 1945 was 171 pounds of berries. This increased to 1,300 pounds in 1946 and in 1947 total yield for the area amounted to 2,600 pounds. The berries were uniformly large with excellent colour. When compared with native vines on an adjacent upland area Early Black and Howes were considerably more productive and Early Black in particular has proved to be more popular from the consumer's standpoint. The Howe variety produces considerably more vine growth and consequently it has been less difficult to keep this section of the bog free from weeds.

Weed Control

At East Point selective weed killers were used as a means of clearing potential cranberry areas of competitive plants. Ammonium sulphamate as a spray or dust at 320 pounds per acre proved very useful in destroying moss, grasses and scrub bushes. Sulphamic acid also proved very destructive to plant growth. Atlacide as a spray at 320 pounds per acre was more effective than an equal quantity applied in the dry form. Sodium arsenite "Weedicide", when applied to a 1/40 acre plot at the rate of 1/3 of a gallon to 5 gallons water, gave a complete kill. In all cases cranberry vines were completely destroyed.

Methods of weed and grass control on established production areas have been studied both on upland soils and on low bog plantations. At East Point, on the upland plantations, it has been found that competitive grasses, weeds and ferns are retarded by annual spring applications of 1,600 pounds per acre of ordinary coarse salt. Cranberry plants are rather tolerant to salt, and where moderate to good stands occur this practice has proved beneficial. On the low bog at Cumberland Point the most effective treatment has been kerosene applied at the rate of 200 gallons per acre using a medium fine spray watering can. Preliminary tests were made using a pressure sprayer but observations to date indicate that the finer spray and lower rate of application does not appear to control the more vigorous growing grasses. Three weeks after treatment with the ordinary watering can, grasses and sedges were either killed or severely retarded and no revival of growth by these plants was noted during the remainder of the season.

Insect Control

The Cranberry fruit worm is the most serious pest growers have to contend with. In order to reduce infestations of this pest the use of insecticidal dusts and sprays has been investigated. At East Point 30 pounds of synthetic cryolite applied as a dust in combination with 70 pounds pulverized gypsum, has given the greatest measure of control. This insecticide was applied at the rate of 50 pounds per acre when about two-thirds of the blooms had fallen. A second application was made eleven days later when 90 per cent of the bloom was off and fruit had just begun to develop. At Cumberland Point the use of 3 per cent DDT dust at 40 pounds per acre has given effective insect control.

TOMATO STUDIES AT OSOYOOS B.C.

The development of experimental work in the Osoyoos district first came about as the result of breakdown in the quality of tomatoes which were the principal cash crop produced in the area. The initial investigations were set up in 1938 and developed as a special project from the Experimental Station, Summerland, B.C. Maintenance of soil fertility, methods of transplanting, variety comparisons and irrigation practices were the main lines of study instituted.

The Okanagan Valley benches are of more or less irregular contour at this point. Silt predominates and is underlain with coarse gravel which in some portions of the area shows in large outcroppings. Organic matter supply is low in the surface soil and the subsoil being gravelly and open has practically no moisture-holding capacity. This situation gave rise to considerable wastage of irrigation water. With limited supplies of water and at the same time a high rate of settlement in the area studies on methods of increasing organic-matter content and moisture-holding capacity were necessary. A cropping system of alternate green manuring crops and truck crops was adopted as one affording the maximum possibility of soil building and providing revenue. The livestock population in the district is low hence very little manure is available. Fall rye and vetch were seeded together at 75 and 25 pounds per acre respectively in the fall immediately following tomato harvest. The crop was grazed lightly in the fall and ploughed under the following spring. Sweet clover where seeded at 20 pounds per acre in the spring without a companion crop produced a hay crop and a strong aftermath for ploughing down in the fall and in this respect has been the most valuable source of green manure.

Fertilizer studies comparing sulphate of ammonia, magnesium sulphate, copper sulphate, boron and ammonium phosphate 16–20–0 were conducted in 1939. There was no particular difference in yield from the various treatments made but it was concluded that a combination of green manuring crops, what manure was available, and the addition of sulphate of ammonia at 250 pounds per acre would sustain yields and maintain quality.

Transplanting

The treatment accorded the tomato plants in the propagating beds and the date they were set out in the field was found to have a definite bearing on date of maturity. It was also found that tomato plants subjected to temperatures lower than 40°F. were liable to produce malformed fruit. Tomatoes for the early semi-ripe trade are produced on the first three trusses. To produce a smooth product for this market it was necessary to grow the plants in the greenhouse until the fruit buds for these trusses would be past the danger point by the time the plants were ready to go into the field. When growing for the canning trade where smoothness is desirable for the main crop, rather than in the first three trusses only, a variation in procedure was instituted. Plants were started later and setting out delayed until there was little danger of ground level temperatures falling below 40°F.

Variety Testing

Tomato varieties commonly grown in the area were Morse's Special Early 498 and John Baer. Variety tests including these two varieties along with Clark's Early, Dick Locke, Sugawara and Earliana 8040 were conducted. After extensive trials it was found that none tested were superior to Morse's Special Early 498 or John Baer.

Irrigation of Tomatoes

Experiments on irrigation practices were conducted through 1938 and 1939. For yield record purposes the crop was all picked as "mature green" or "semi-ripe". The experiment comprised three single rows 360 feet in length under each treatment. Length of row was found to be important because where water was let in at the end much more was required than necessary in order that the furthermost plants in the row would be irrigated. On this soil a row length of from 180 to 200 feet would be more satisfactory. Where water was applied in weekly applications of 1·00 inches in June and 1·50 inches in July and August the average yield per row was 637·0 pounds. When water was applied at the rate of 1·25 inches per week in June and 2·00 inches per week in July and August the average yield was 685·3 pounds per row. Higher weekly rates of application of 1·50 inches in June and 3·00 inches in July and August gave an average yield per row of 662·6 pounds. It is observed that the moderate rates of water used were fully as satisfactory and are recommended where conservation of water supply is required.

RASPBERRY STUDIES AT HATZIC B.C.

Preliminary studies on raspberries were instituted on the Hatzic Illustration Station in 1934. Raspberry plantings in the Hatzic area were declining in vigour to a point where commercial production was not possible. The necessity of providing a possible solution to the problem was urgent in view of the importance of the small fruit industry to the economy of the district. The case histories of eight different farms in the district were closely reviewed during the summer of 1938. Results of this detailed survey indicated that where supplies of farm manure were available and rotations including sod crops were followed the decline in vigour and productivity of raspberry plantings was less severe.

Thus tests employing straw mulches, green manure crops, chemical fertilizers and trace elements such as, copper, zinc, iron, magnesium, sulphur and boron were undertaken. These materials were available to the average grower who was getting along without the benefit of livestock.

Straw Mulch

The procedure followed was the application of straw between the rows at the rate of 8 tons per acre. This application formed a layer about 4 inches deep and served to check weed growth until late in the season. The straw mulch was largely rotted the year laid down since sulphate of ammonia at 250 pounds per acre was applied to maintain nitrogen supplies for the raspberries. Results from this treatment were not satisfactory since the cane growth on the mulched plot was not appreciably improved in comparison with the check area.

Green Manure Crops and Chemical Fertilizers

Green manure crops of red clover and fall rye made luxuriant growth and were ploughed under previous to planting new stock. Rye was also seeded between the rows of established plantings in the fall for ploughing in the following spring. The labour requirements for this practice were such that it was discontinued and clean cultivation of the planted areas was adopted. Experimental work with chemical fertilizers showed that very little response was derived from other than nitrogen. In view of the importance of this element and the beneficial results obtained from green manures the experiment was revised in 1938 and a procedure developed to compare various sources of organic matter. Plantings were made to compare (1) continuous sod crops, (2) continuous clean cultivation and sod crops and (3) annual application of farm manure to a planted area. The procedure under (1) was the setting out of single rows on areas that had been under sod one, two, three and four years respectively. Where clean cultivation versus sod crops was compared one-half of the area was clean cultivated in 1941 and 1942 the other half being seeded to fall rye, clover and grasses. In 1943 a first planting of canes was made with the rows running across both the clean cultivated and the sod areas. Subsequent plantings were made in the same manner in 1944 and 1945. No apparent differences in cane growth nor in fruit production obtained between the two areas. In treatment No. 3 manure was applied annually at 20 tons per acre over the entire row area. Prior to this treatment no satisfactory stand of canes had been obtained on these plots which now produce at a rate ranging from 7·56 to 9·61 tons of fruit per acre annually.

TREE FRUIT VARIETY TESTS

A study of the factors which contribute to the establishment of tree fruit plantations has been carried out in co-operation with the Division of Horticulture, Central Experimental Farm, Ottawa, and the branch Experimental Farms and Stations in the different provinces. When developing the organization and farm layout of the properties operated as Illustration Stations and Substations, space is allocated and plans made for the development of a home orchard in areas where such an undertaking has practical possibilities. The idea is to provide, insofar as it may be possible, within each farm unit an adequate supply of apples, plums and small fruits for home use. This project started on the Illustration Stations in Nova Scotia and has been enlarged and extended to the stations in each of the other provinces. When undertaking this project due consideration is given to such factors as locating a well drained soil, use of hardy varieties, suitable exposure, protection from high winds through tree plantations or shelterbelts, control of damage from mice and rabbits. Adequate shelter is a major requisite to the successful growing and production of fruits in northern and prairie areas. On a number of stations where the orchard has been protected on all sides, there has been little winter-killing even in the tree fruit varieties which are generally considered semi-hardy. In other localities it has been found advisable to leave one side partially open to allow satisfactory air drainage and thus lessen the exposure to late spring and early fall frost damage.

In many of the districts where these stations are located, information is lacking as to the comparative adaptation of the different varieties of fruit to the local soil and climatic conditions. Thus the testing of hardy varieties and new originations is a standard undertaking on the stations in the Prairie Provinces and where new productions require further testing to determine their zonal adaptation. For the stations in the Eastern Provinces these new introductions have for the most part been originated at the Central Experimental Farm, Ottawa, and for the Prairie Provinces at the Experimental Station, Morden, Manitoba. Extensive varietal tests are under way at Alliston, P.E.I.; Fort William, Ont.; Kenville, Man.; Avonlea and Parkside, Sask.; Castor and

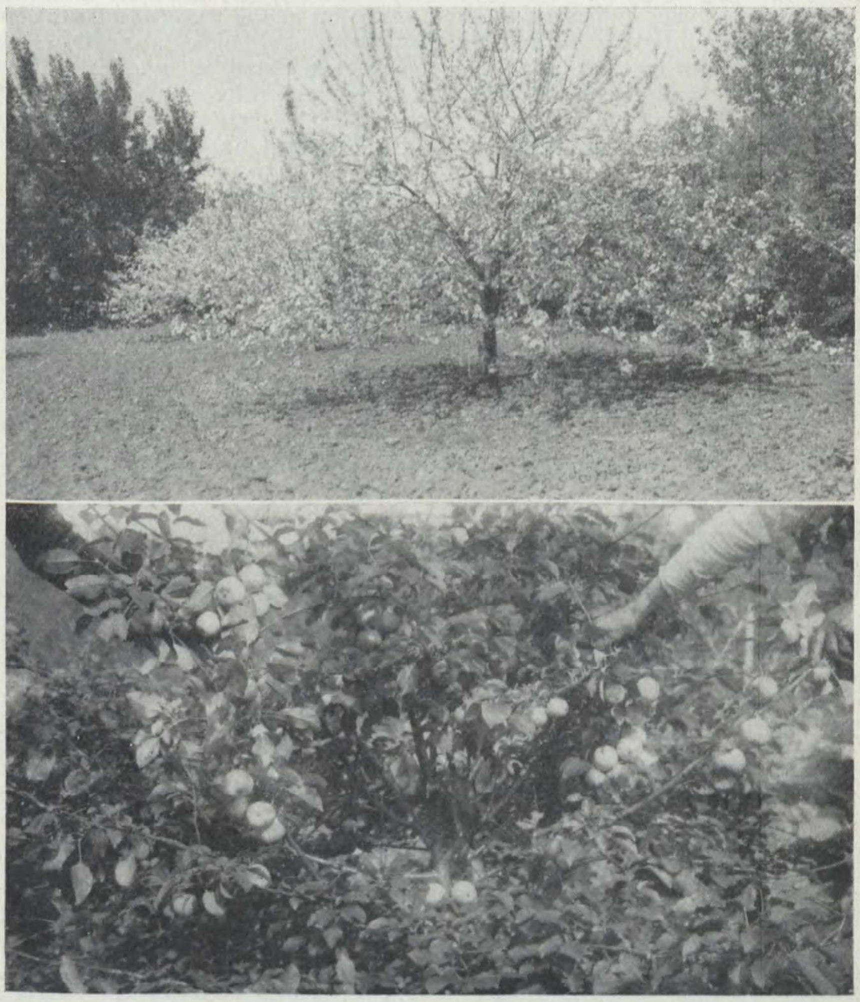


FIG. 22.—(Upper): Florence crab in bloom at Avonlea Sask., 1943. Note clean cultivation for moisture conservation and weed control. (Lower): Set of fruit on Rosthern Seedling Apple No. 15 at the Parkside, Sask. Illustration Station, 1942.

Chedderville, Alta.; and Creston, B.C. At some of these stations and at Black River Bridge, Cumberland Point, Currieburg and Pomeroy Bridge, N.B., a co-ordinated root and frame work stock test is under way. In this project hardy varieties of little commercial value but having extremely hardy wood and strong angle crotches are planted to form the main scaffold branches of the future trees. These hardy stocks are later grafted with superior commercial varieties such as McIntosh, Melba, Lobo, Atlas, Joyce, Cortland, Lawseed, Linda, Lawfam, Sandow, etc.

On the stations in the Prairie Provinces apple varieties such as Blushed Calville, Hibernal, Heyers No. 6 & 12, Mantan, Mortof, Reward, Rescue and Duchess are planted. The crabapple varieties such as Calross, Anaros, Florence, Dolgo, Osman and Roblin have been quite consistent producers of large fruit in tests on the stations, other than during very dry seasons. Plum varieties under test have included Assinboine, Bounty, Fiebing, Grenville, Mammoth, McRobert, Mina, Olson, and Tecumseh. The results of these tests carried out over a period of years indicate a marked variation in the varietal adaptation of tree fruits under different soil and climatic conditions, hence the inadvisability of making general recommendations. Those interested in establishing fruit plantations can obtain specific information in this regard by visiting their nearest Illustration Station, the locations of which have been listed in an earlier section of this report, and by communicating with the nearest Experimental Farm.

ORCHARD FERTILITY STUDIES

Fertility studies with tree fruits have been conducted on Illustration Stations in commercial fruit areas. These tests have been developed to determine the best means of maintaining general productivity and quality involving management practices as well as fertilizer treatment. An example of the type of test conducted is that under way at Bloomfield in Prince Edward county, Ontario. This experiment was laid down in 1939 and comprised three cultural practices and two types of fertilizer treatment. The work was done on a block of McIntosh in which the average age of tree was approximately thirty years.

The experimental area consisted of three plots each containing forty trees. Plot 1 was ploughed each year in early spring or the previous fall and cultivated

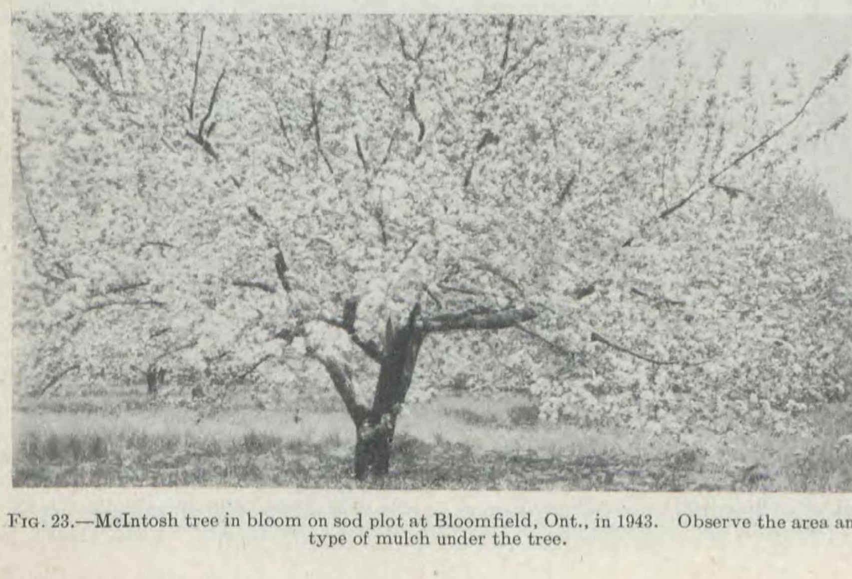


FIG. 23.—McIntosh tree in bloom on sod plot at Bloomfield, Ont., in 1943. Observe the area and type of mulch under the tree.

until late June. Crown millet was sown as a cover crop at the rate of 20 pounds per acre. The crop was cut or rolled down before apple picking. In late fall a mulch of straw or pea refuse was applied around the trees. Plot 2 was ploughed each year in early spring and 600 pounds of 4–8–10 fertilizer plus 15 tons per acre of barnyard manure was applied at about the time of the green tip spray. The area was cultivated as necessary until late June and a cover crop of Crown millet was seeded at 20 pounds per acre. The resulting crop of millet was cut or rolled down as in Plot 1 and left on the ground to provide a source of organic matter. Plot 3 was seeded in 1939 to a mixture of 5 pounds of timothy, 8 pounds of orchard grass, and 5 pounds Kentucky blue grass per acre. Each year the ensuing hay crop was cut approximately twice in the season, the first cut being mulched around the trees with the second crop left lying where cut to provide organic matter. Chemical fertilizer having the formula 9–5–7 was applied each spring at the rate of 500 pounds per acre. When required, an additional mulch of approximately 75 pounds of straw per tree was applied in the fall.

Individual tree yields were taken through the years 1939 to 1946 inclusive. The results derived from this experiment on the basis of comparative yields per acre for the different treatments are summarized in Table 11.

TABLE 11.—METHODS OF MAINTAINING FERTILITY IN AN ESTABLISHED ORCHARD, BLOOMFIELD ILLUSTRATION STATION, 1939 TO 1946 INCLUSIVE

Plot No.	Treatment per acre	Average Yield of Apples per acre 1939–1946
		bu.
1	Cultivation cover crops and mulch	619·3
2	Cultivation and cover crop Manure 15 tons + 600 lb. 4–8–10 fertilizer	666·9
3	Sod mulch + 500 lb. 9–5–7 fertilizer. Additional straw mulch when required	671·6

From the standpoint of economy and sustained yields, the sod mulch plot is quite attractive. This treatment requires practically no cultural operations apart from periodic clipping of the sod crop. Where soil erosion by water is a problem, this method is valuable as a conservation measure.

DEVELOPMENT OF THE FARM GARDEN

On the Illustration Stations and Substations the farm garden is an associated enterprise in a livestock or specialized grain-farming setup. Records assembled from these units indicate that the value of vegetables consumed within the household, or sold where a surplus exists, totals approximately 3 per cent of the net farm income. Being usually located adjacent to the home and farm buildings, the soil is not always that regarded as most suitable to the production of vegetable crops. Under such conditions the soil has been materially improved by ploughing under farmyard manure or a cover crop. In this way organic matter is introduced which makes the soil more friable, easier to work and more productive. In size the objective is to have these farm gardens large enough in area to provide a variety of desirable vegetables for family use throughout the growing season and for the winter months. Considerable manual labour is saved when the garden area is large enough to permit machine cultivation and with rows far enough apart to provide adequate spacing for corn, cauliflower, peas, beans and even crops such as cucumbers, pumpkins, and squash. On the stations in the

Prairie Provinces the objective is to locate the garden within the shelterbelt which surrounds the buildings. In this way it is protected from high winds and benefits from the moisture resulting from the snowfall which collects within the belt during the winter months. In areas of low seasonal precipitation where at all possible half the garden area is summerfallowed in alternate years. Thus the vegetables benefit from the reserve moisture conserved from the previous season. A number of the farmers operating Illustration Stations have excavated dugouts close enough to the garden to make it possible to irrigate the vegetables when natural precipitation proves inadequate. As a number of the stations are located in northern areas subject to late spring and early fall frosts, the use of early, productive and the best adapted varieties is essential. Even when these conditions are adequately considered crops such as tomatoes, corn and vine crops are frequently destroyed by frost prior to reaching maturity. For this reason a great deal of work in connection with the breeding and testing of early and better adapted vegetable varieties is a major undertaking on the Experimental Farms. As an extension of this work the testing of different

FIG. 24.—Farm Home, St. Pierre Illustration Station, 1947. This house is over 100 years old. The development of flower borders and the planting of hardy decorative shrubs is an important project.

species and varieties of vegetables is undertaken on each of the Illustration Stations across the Dominion. Of the garden crops grown the varieties listed below have been found to have wide adaptation and may be regarded as standard for use and comparative purposes with other promising varieties being offered for local sale.

Beets—Improved Detroit, Detroit Dark Red.
Beans—Pencil Pod Black Wax, Stringless Green Pod, Tender Green.
Peas—Thomas Laxton, Stratagem, Little Marvel, Onward, Lincoln.
Corn—Spancross, Dorinny, Golden Bantam.
Carrots—Chantenay, Red Cored, Nantes.
Onion—Yellow Globe Danver, Sweet Spanish, Red Wethersfield.
Cabbage—Golden Acre, Copenhagen Market (early) Danish Ballhead (late).
Lettuce—Grand Rapids, New York 12.
Cucumber—Straight 8, Delcrow, White Spine.
Radish—Scarlet Turnip W. Tip, Firecracker, Icicle.

Tomato—Early Chatham, Bounty, Earliana, John Baer.
Parsnip—Hollow Crown, Short Thick Guernsey.
Pumpkin—Small Sugar, Connecticut Field.
Squash—Hubbard, (Green and Golden).
Cauliflower—Snowball.
Turnip—Canadian Gem, Laurentian.

ESTABLISHMENT OF FARM SHELTERBELTS

Several divisional projects, farm enterprises and undertakings are featured in an investigational way because of their effect on the monetary returns of each organization. In the case of farm shelterbelts, however, they have the added benefit of enhancing the appearance of the farmstead, of providing comfort and protection to members of the household as well as the livestock by reducing the penetrating capacity of the cold winter winds. The direct and indirect value of trees, hardy shrubs and shelterbelts about the buildings, paddocks and gardens became a project of increased activity with the inauguration of the Prairie Farm Rehabilitation program on the Illustration Stations and Substations in 1935. This necessitated the renovation of many of the older plantations as well as the setting out of a large number of trees for the establishment of new shelterbelts. Both deciduous and coniferous trees have been supplied from the Forest Nursery Station at Indian Head in southern Saskatchewan. These trees have been planted out in keeping with a plan prepared and supplied to the operators by this institution. During the period in question the farmers operating these stations have planted 38,248 coniferous trees made up of Colorado spruce, white spruce and Scotch pine. The plantings of deciduous trees included 22,900 maple, 39,775 ash, 31,250 elm, 11,150 poplar, 425 cottonwood, 3,950 willow and 169,425 caragana. Thus during the period 1935–1946 inclusive plantings of coniferous, deciduous and ornamental trees on the farms operating as Illustration Stations and District Experiment Substations totalled 278,995.

FIG. 25.—Tree shelterbelt at Lyleton, Man., in 1940. Alternate plantings of coniferous and deciduous trees are made according to an established plan. Observe clean cultivation to control weed growth between the trees.

LIVESTOCK PRODUCTION

The importance of livestock in the overall economy of Canadian agriculture is shown by the fact that in only one district of supervision during the period 1943 to 1947 inclusive did revenue from this source comprise less than 20 per cent of farm cash income. This occurred in the Swift Current district of supervision where the prevailing soil types and climatic conditions are particularly suitable for grain crops and forage crop production is limited. The advantages derived from high quality livestock enterprises are emphasized by case studies made on 63 station farms in Ontario and Quebec. Thirty-one of these farms were above average from the standpoint of proportion of investment in productive livestock. The average cash revenue per crop acre for this group was $52.36 or $11.33 above that recorded by the thirty-two farms which were below the group average. Gross revenue per crop acre varied from $28.39 for the station with the lowest producing dairy herd to $84.45 per acre where the highest producing stock were maintained. While this particular study dealt exclusively with dairy farms the same principle applies for all classes of productive livestock.

Work with livestock on Illustration Stations is conducted with the purpose of developing high quality herds and flocks which will make effective contributions to farm revenue. In the case of dairy and beef cattle, operators are encouraged to maintain high quality purebred sires at the head of the herds. Milk records are kept in each dairy herd and selection of individual cows as foundation stock is based on production and breed type. With swine, selection of breeding stock is based on freedom from inherited deformities, prolificacy, growthiness, and grading records. Poultry work on station farms is designed to promote the maintenance of improved farm flocks. In more commercialized poultry areas many operators have developed large breeding flocks and make extensive sales of cockerels, pullets, baby chicks and hatching eggs.

Surplus from station herds and flocks sold as breeding stock during the ten-year period 1938 to 1947 inclusive totalled 3,281 cattle, 4,229 hogs, 751 sheep, 19,600 cockerels, 43,095 pullets and 126,527 dozens of hatching eggs.

FARM BUSINESS STUDIES

A co-ordinated farm business study is conducted on all Illustration Station and District Experiment Substation farms. Each week every operator forwards a summary sheet outlining revenues and expenses for the seven-day period to the office of the district supervisor. At the end of each year a complete farm inventory is taken on each property and information is gathered on the utilization of land areas, investment in land and buildings, livestock, machinery and equipment and carryover of feeds, seeds, and supplies. Identical procedures are followed in all districts of supervision throughout the Dominion thus providing data which permit studies of farming types and the effectiveness of experimental procedures under a great variety of conditions.

Sources of Revenue

A study of revenue records collected during the period 1943 to 1947 inclusive indicates the relative importance of the various farm enterprises in different sections of the Dominion. From the standpoint of farming types two broad classifications of areas can be made based on the percentage contribution to farm revenue by the different farm enterprises. In British Columbia, Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island cattle and dairy products provided 42·65 per cent of total revenue, whereas in the three Prairie Provinces receipts from this source totalled 23·87 per cent. Conversely, receipts from field crop sales comprised 50·24 per cent of total income in the Prairie Provinces and 16·08 per cent in British Columbia and the Eastern

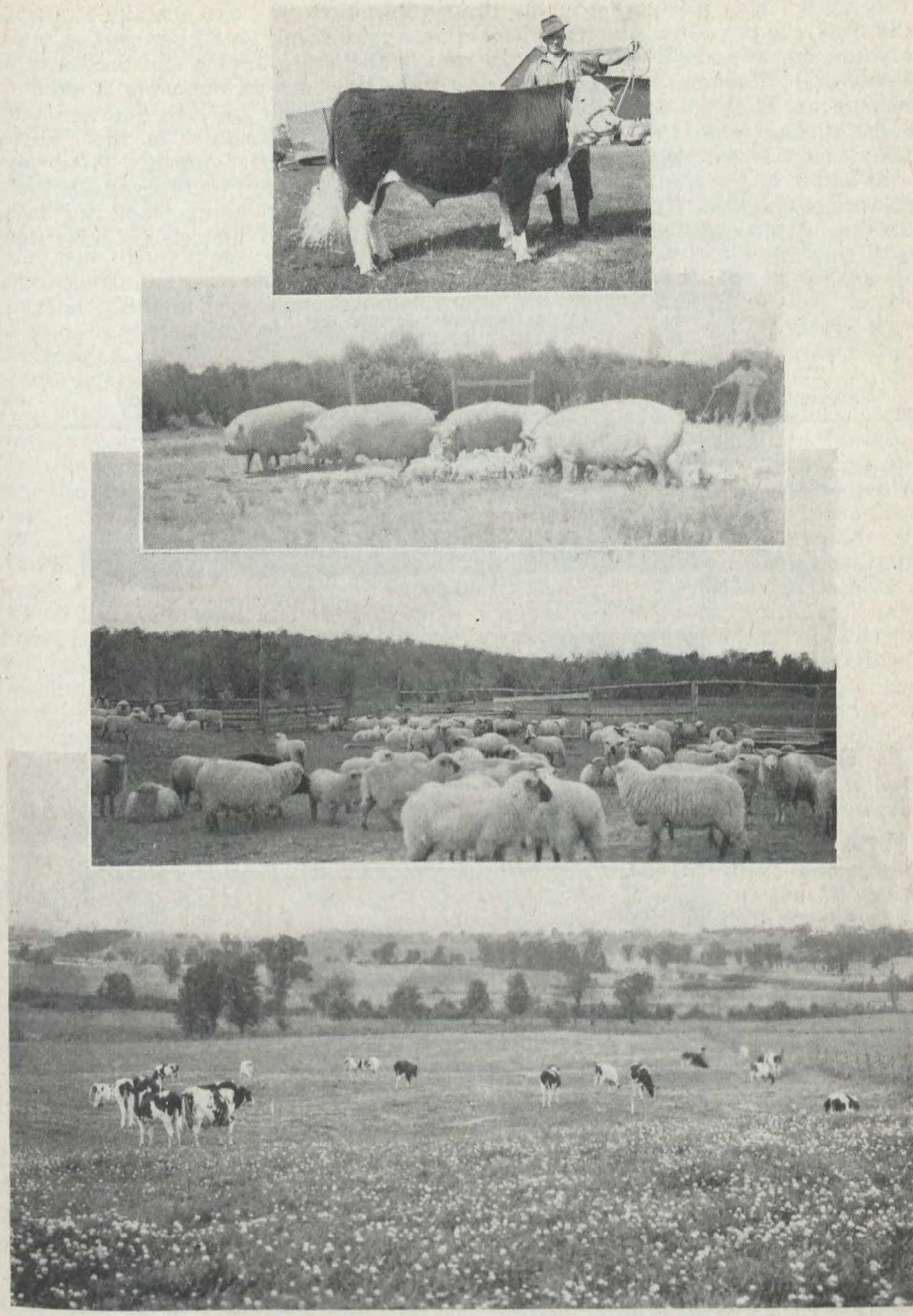
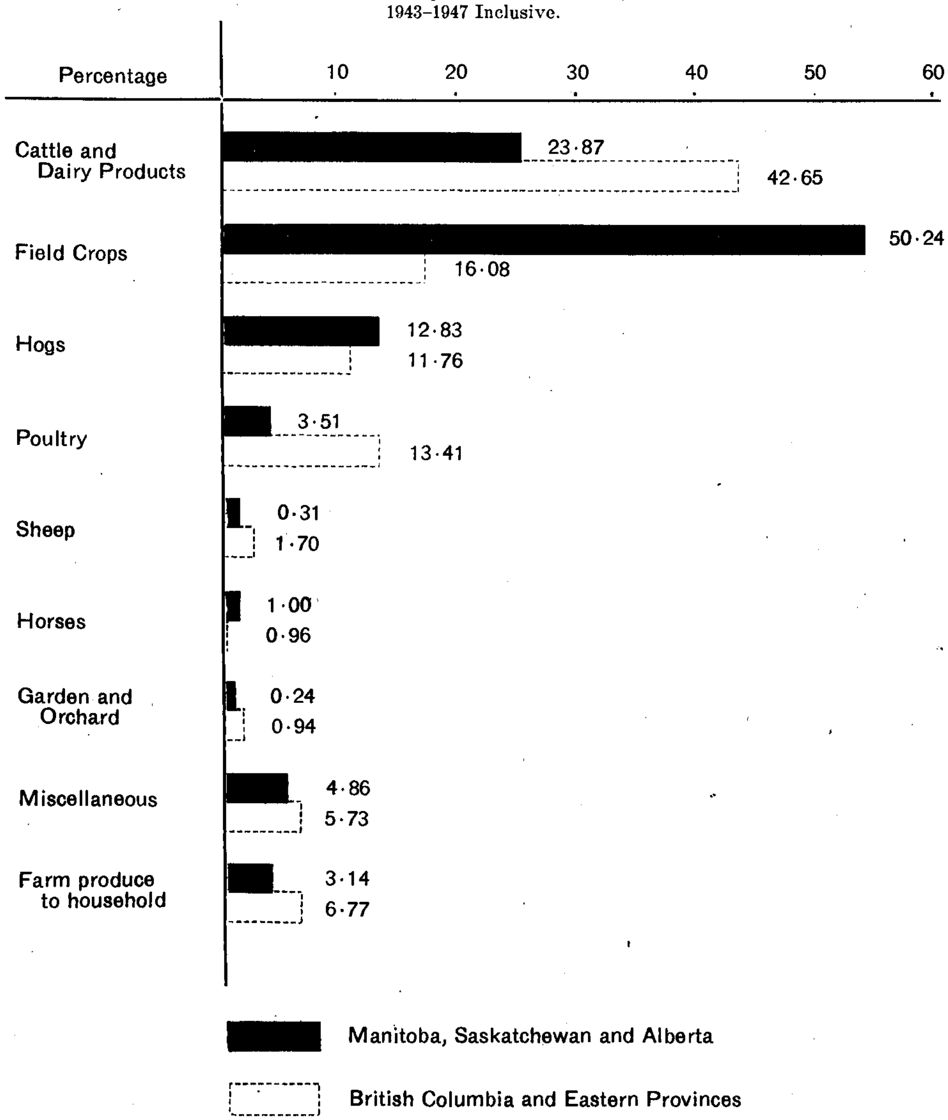


Fig. 26.—(Top to Bottom): First-prize steer from the Silverton, Man., Illustration Station herd, 1944. Brood sows on the substation at Radville, Sask., 1944. Sheep on the Mindemoya Illustration Station, Manitoulin Island, Ont., 1943. Holstein herd on the Arthabaska, Que., Illustration Station, 1940.

Provinces. Hog production in the Prairie Provinces was well sustained during the five-year period receipts from this source comprising 12·83 per cent of total revenue in comparison with 11·76 per cent in British Columbia and the Eastern Provinces. Revènue from poultry enterprises has been an important source of income on British Columbia and eastern station farms but, on the average, contributions from this source were of secondary importance in the Prairie Provinces. Farm produce consumed in the households comprised 3·14 per cent and 6·77 per cent of income on stations in the Prairie Provinces and British Columbia and the Eastern Provinces. respectively. A summary of the data dealing with sources of revenue for the period 1943–1947 inclusive is presented in Figure 27.

FIG. 27.—Sources of Revenue, Illustration Stations AND District Experiment Substations, 1943–1947 Inclusive.



Use of Capital

The proportionate investment in land and buildings, livestock, and machinery and equipment under the various types of farming in Canada is shown by inventory records on station farms. In Western Canada, particularly in the Prairie Provinces, the greatest proportion of capital invested is usually in the form of land and machinery. In the more diversified farming districts in these same areas a greater proportionate investment in productive livestock is found. This is also the case in British Columbia and the Eastern Provinces where investment in livestock is considerably greater and in view of the type of buildings and equipment required to house and care for stock the investment per acre of crop land is considerably higher. In the main, size of farm in acres of crop land is considerably less in the more diversified areas. The data collected on station farms during the period 1943 to 1947 giving particulars on capital investment and relative productivity of capital in each district of supervision is summarized in Table 12.

Size of farm in acres of crop land is considerably greater on the station farms in the specialized grain areas in southern Saskatchewan and southern Alberta. In the slightly more diversified farming areas in Manitoba, northern Saskatchewan, central Alberta and the Peace River District farm size is considerably less. In British Columbia and the Eastern Provinces size of farm is smaller than in the three Prairie Provinces. In view of the greater concentration of productive livestock on these farms the investment per acre is much higher and returns per acre of land under crop are greater than in the specialized grain areas. From the standpoint of return in gross receipts per dollar of capital invested there is rather close relationship between all districts of supervision. In British Columbia and Eastern Canada the proportionate investment in productive livestock on stations has had an important bearing on farm income. This is also true of the station farms in the more diversified farming areas in the Prairie Provinces. Effective use of rough land as pasture has permitted the development of livestock enterprises in the more northerly areas and in parts of the south such as southeastern Saskatchewan and southwestern Alberta. Where such rough land pastures have been available and made use of a substantial increase in the earning capacity of the farm has resulted.

In Eastern Canada the maintenance of high quality livestock enterprises from the standpoint of productivity is important. Records on the Western Quebec station farms serve to substantiate this statement. This group of farms lies in a predominantly livestock-producing area. During the period in which these records were taken the supply of labour in this area was limited due to demands of war industries in the adjoining city of Montreal. Livestock population was reduced because of shortage of labour and the acre revenue on this group of farms averaged $39.59 in comparison with $55.86 in adjoining eastern and central Ontario. The growing of crops for cash sale did not provide a volume of income sufficient to compensate for the high capital investment already made in buildings and equipment for livestock enterprises and which were not being employed to the fullest extent. 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 Producing Farm Crops

The cost of producing a unit of crop is an important factor in the overall effectiveness of the farm business. This is particularly true of crops which are produced for direct sale through commercial channels in their natural state. On Illustration Stations and District Experiment Substations in the Prairie Provinces cost studies on wheat production have been conducted within the

TABLE 12.—AVERAGE CAPITAL INVESTMENT, ACRES OF CROP LAND PER FARM AND GROSS RECEIPTS PER ACRE OF CROP LAND. ILLUSTRATION STATIONS AND DISTRICT EXPERIMENT SUBSTATIONS 1943-1947 INCLUSIVE

Province and District	Land and Buildings		Livestock		Machinery and Equipment		Total Capital	Acres of crop land per Farm	Investment per acre of crop land	Gross Receipts per acre Crop land
	Amount	Per cent of Total	Amount	Per cent of Total	Amount	Per cent of Total				
	$ cts.	%	$ cts.	%	$ cts.	%	$ cts.	acres	$ cts.	$ cts.
British Columbia	10,338 66	66·62	2,999 64	19·32	2,182 71	14·06	15,521 01	83·9	184 99	49 08
Peace River District	6,678 71	58·05	1,933 69	16·80	2,895 19	25·15	11,507 59	189·7	60 66	17 34
Central Alberta	10,564 01	54·50	5,069 03	26·14	3,755 18	19·36	19,388 22	492·8	39 34	15 14
Southern Alberta	19,257 04	63·05	4,762 59	15·59	6,527 81	21·36	30.547 44	829·3	36 83	11 94
Southwestern Saskatchewan	18,282 50	71·69	1,928 65	7·56	5,292 18	20·75	25,503 33	556·3	45 84	14 04
Northern Saskatchewan	11,047 77	63·50	2,494 28	14·33	3,857 67	22·17	17,399 72	362·9	47 94	17 07
Southeastern Saskatchewan	16,357 78	62·84	4,371 31	16·74	5,319 44	20·42	26,048 53	631·6	41 24	14 92
Manitoba	9,343 77	57·41	3,685 53	22·64	3,248 95	19·95	16,278 25	366·9	44 36	16 97
Fort William	8,784 16	64·72	2,566 91	18·91	2,223 02	16·37	13,574 09	133·3	101 83	35 75
Northern Ontario and Northern Quebec	6,058 96	59·72	2,081 53	20·51	2,006 47	19·77	10,146 96	88·6	114 52	50 35
Eastern and Central Ontario	10,610 04	59·95	4,150 76	23·43	2,950 52	16·65	17,711 32	92·3	191 88	55 86
Western Quebec	18,094 02	77·18	2,534 44	10·80	2,820 00	12·02	23,448 46	112·7	208 06	39 59
Central Quebec	7,674 50	61·53	2,487 66	19·94	2,312 03	18·53	12,474 19	57·5	216 94	75 73
Eastern Quebec	5,832 05	61·64	1,814 07	19·17	1,816 47	19·19	9,462 59	77·1	122 73	38 35
Lake St. John (Que.)	7,813 52	62·18	2,678 26	21·31	2,076 05	16·51	12,567 83	89·1	141 05	44 58
New Brunswick	5,584 15	62·00	1,777 98	19·73	1,646 03	18·27	9,008 16	48·9	184 21	64 23
Nova Scotia	7,708 01	62·87	2,920 82	23·82	1,632 50	13·31	12,261 33	45·2	271 26	99 99
Prince Edward Island	6,210 16	67·05	1,607 74	17·35	1,448 01	15·62	9,265 91	56·5	163 99	48 75

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 seasonal conditions but also to evaluate the importance of the factors which contribute to costs and to arrive at a method of production whereby such costs might be materially lessened. The importance of proper tillage practices to conserve moisture, the use of good seed and year-round soil conservation practices has been emphasized by the records derived from this project. In the main it has been found that more than 60 per cent of the cost of producing wheat has been incurred by the time the seed is put in the soil. These charges include cost of summerfallow from the previous year; taxes; interest on investment; hail insurance; use of tillage, seeding machinery and power equipment; seed and a return to the farm owner in his capacity as manager. The very nature of these relatively fixed costs emphasizes the importance of proper tillage, good seed and effective seeding practices. For practically no other crop can it be said to the same extent that this year's tillage determines next year's crop. For this reason summerfallow practices are extremely important and the variance in number of operations depends on many factors the most important being soil type, extent and species of weed infestation and mean precipitation in each area. Earlier in this report the importance of depth of soil moisture at seeding time on the yield of wheat on both fallow and stubble has been emphasized. This factor alone has a most important bearing on the ultimate cost per bushel to the farmer. The data on cost of fallowing and average yield of wheat per acre on fallow on station farms through varying periods of years is summarized in Table 13. In this table the following abbreviations with respect to soil texture are used: S.—sand; L.S.—loamy sand, C.S.—coarse sand, L.C.S.—loamy coarse sand, S.L.—sandy loam, F.S.L.—fine sandy loam, V.F.S.L.—very fine sandy loam, L.L.—light loam, L.—loam, Si. L.—silt loam, Si. C.L.—silty clay loam, C.L.—clay loam, C.—clay, H.C.—heavy clay, F.S.C.L.—fine sandy clay loam.

TABLE 13.—COST OF SUMMERFALLOW AND YIELDS OF WHEAT AFTER SUMMERFALLOW ON ILLUSTRATION STATIONS AND DISTRICT EXPERIMENT SUBSTATIONS, FOR VARIOUS PERIODS OF YEARS

Station and Soil Zone	Soil Type	Period	Number of Years	Cost of Summer-fallow	Average Yield per acre
				$ cts.	bu.
Manitoba:					
Dark Brown—					
Boissevain	Waskada H.L. and C.L.	1946–1947	2	4 93	25·0
Goodlands	Waskada C.L.	1937–1947	10	4 77	23·5
Pipestone	Bede L.C.S. and S.L.	1937–1947	10	3 58	11·4
Black—					
Crystal City	Carroll F.S.L. and F.S.C.L.	1938–1947	9	5 01	21·3
Dugald	McTavish C.	1937–1947	10	5 65	30·8
Gilbert Plains	Gilbert S.L. and F.S.L.	1937–1947	10	6 15	24·6
Hargrave	Oxbow H.L.	1938–1947	9	5 51	24·8
Katrime	Newton F.S.C.L.	1937–1947	10	6 39	30·0
Lyleton	Souris L.	1937–1947	10	4 20	22·4
Silverton	Newdale C.L.	1937–1947	10	6 01	26·7
Grey—					
Arborg	Arborg C.L. and C (High Lime)	1937–1947	10	6 85	28·5
Lenswood	S.L. (Grey Black)	1941–1947	7	6 87	30·1
Swan River	.... (Grey Black)	1937–1947	10	6 11	34·4
Saskatchewan:					
Brown—					
Bracken	Haverhill and Echo C.L.	1936–1947	12	2 56	14·0
Conquest	Asquith F.S.L.	1946–1947	2	5 71	11·5
Fox Valley	Fox Valley Si. C.L. and L.	1936–1947	12	2 72	16·2
Gravelbourg	Sceptre C.	1936–1947	12	4 73	20·6
Kincaid	Fox Valley Si. C.L.	1936–1947	12	3 67	20·4
Kindersley	Sceptre H.C.	1934–1947	14	3 99	16·5
Limerick	Haverhill C.L.	1936–1947	12	3 97	16·3

TABLE 13.—COST OF SUMMERFALLOW AND YIELDS OF WHEAT AFTER SUMMERFALLOW ON ILLUSTRATION STATIONS AND DISTRICT EXPERIMENT SUBSTATIONS, FOR VARIOUS PERIODS OF YEARS—*Concluded*

Station and Soil Zone	Soil Type	Period	Number of Years	Cost of Summer-fallow	Average Yield per acre
				$ cts.	bu.
Saskatchewan—Con.					
Brown—Con.					
Lisieux	Wood Mountain L. and Haverhill L.	1934–1947*	13	3 39	11·9
Loverna	Fox Valley Si. C.L.	1929–1947	18	3 35	11·1
Pambrun	Sceptre and Haverhill S.C.L. and C.L.	1946–1947	2	3 00	9·4
Shackleton	Sceptre C. and Fox Valley C.L.	1938–1947	9	3 54	15·0
Shaunavon	Haverhill and Cypress C.L.	1940–1947	8	3 78	17·6
Valjean	Hatton F.S.L.	1936–1947	12	2 93	12·8
Dark Brown—					
Arcola	Asquith L.L. and F.S.L.	1938–1947	10	3 92	22·8
Aylesbury	Weyburn L.	1938–1947	10	3 69	15·0
Carmichael	Cypress C.L.	1936–1947	12	3 41	16·5
Guernsey	Asquith L.L. and F.S.L.	1936–1947	12	3 72	20·5
Radville	Trossacks C.L.	1935–1947	13	3 20	20·4
Rosetown	Regina C.	1937–1947	11	4 96	20·8
Strasbourg	Weyburn L. and L.L.	1937–1947	11	4 01	19·9
Tugaske	Weyburn L. and L.L.	1936–1947	12	4 00	21·1
Black—					
Alameda	Oxbow and Estevan L.	1937–1947	11	3 58	18·7
Birch Hills	Melfort Si. C.L.	1936–1947	12	4 68	30·0
Hafford	Cudworth and Blaine Lake L.	1935–1947	13	3 54	15·6
Wawota	Ryerson and Oxbow L.	1925–1947	23	4 09	18·9
Weirdale	Whitewood L.	1943–1947	5	4 59	27·9
Yorkton	Canora Si. C.L.	1936–1947	12	5 11	23·2
Grey Wooded—					
Carragana	Etomami and Tisdale C.	1933–1947	15	4 50	38·0
Glenbush	Glenbush L. and S.L.	1947	1	5 25	16·5
North Makwa	Loon River and Horsehead L.	1947	1	8 42	35·0
Parkside	Shellbrook F.S.L.	1936–1947	12	4 32	18·0
White Fox	Shellbrook F.S.L.	1936–1947	12	5 15	23·0
Snowden	Waitville C.L.	1944–1947	4	5 53	14·0
Alberta:					
Brown—					
Acadia Valley	Lacustrine C. and C.L.	1939–1947	9	2 90	24·3
Bindloss	Eolian Si. L.	1935–1947	13	2 24	14·0
Foremost	Lacustrine and Glacial Si. L. and C.L.	1937–1947	11	2 55	19·0
Lomond	Glacial C.L.	1935–1947	13	2 72	14·3
Whitla	Glacial L.	1935–1947	13	1 99	9·3
Dark Brown—					
Castor	Solonetzic Si. L.	1938–1947	10	3 11	14·9
Chauvin	Alluvial and Eolian L.	1933–1947	15	4 28	22·8
Claresholm	Alluvial and Lacustrine F.S.L. and S.L.	1937–1947	11	1 63	20·4
Craigmyle	Alluvial and Glacial L.L.	1939–1947	9	3 47	21·5
Drumheller	Lacustrine C.L. and C.	1937–1947	11	2 89	19·0
Metiskow	Alluvial S. and L.S.	1938–1947	10	2 69	13·1
Nobleford	Lacustrine Si. L.	1939–1947	9	6 22	31·3
Black—					
Fairview	Shallow Black L.	1944–1947	4	5 15	17·7
Pincher Creek	Lacustrine C. and L.	1943–1947	5	3 41	21·6
Grey—					
Debolt	Lacustrine L. and C.L.	1946–1947	2	6 53	22·5
Goodfare	Glacial L.	1945–1947	3	3 68	9·3
Baldonnel B.C.	Lucustrine and Alluvial L.	1946–1947	2	5 38	27·9
Progress B.C.	Alluvial L.	1943–1947	5	3 41	21·6

* 1941 to 1944 inclusive not in average.

Summerfallow costs tend to be higher in the black and grey wooded soil zones than in the dark brown and brown soil zones. Ordinarily moisture conditions are such that materially higher yields are recorded which serves to allow production at costs comparable with the larger farm units in the more specialized wheat areas. In the grey wooded areas many of the station farms still use horses as a source of power. With the smaller sized implements employed and the greater time required per acre of land, man labour per acre is increased and constitutes a large portion of summerfallow costs. The effect on cost of high priced land with high land-use charges and higher taxes per acre is demonstrated

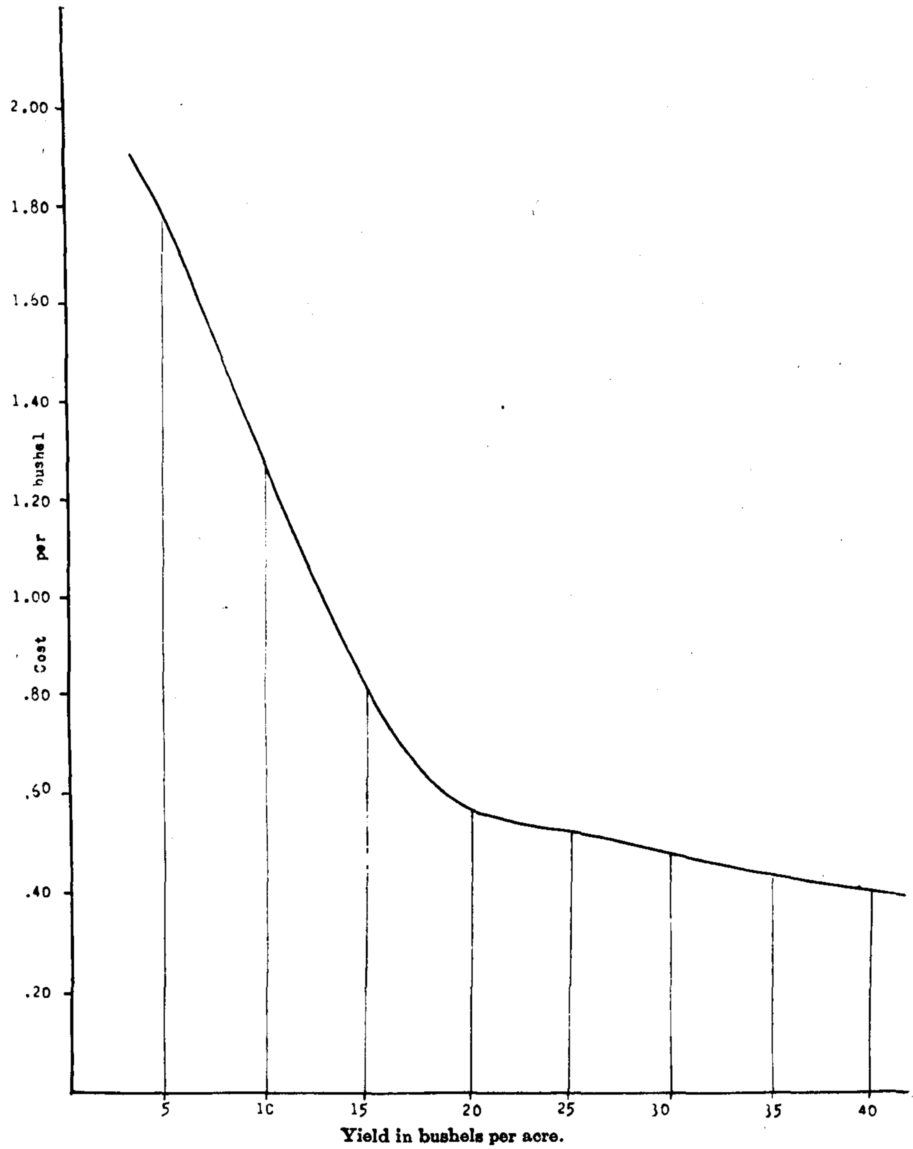


FIG. 28.—The Relationship of Yield of Wheat per Acre and Cost per Bushel on Illustration Stations and District Experiment Substations for Varying Periods of Years between 1925 and 1947.

at Nobleford in southwestern Alberta. At Claresholm in Alberta the low cost of summerfallow results from a credit for use of cover crops as pasture which constitutes a reduction from the total cost of summerfallow.

In compiling the cost per acre of producing wheat the items involved include charges for land use and taxes, cost of fallowing the previous year, seed, field operations, hauling to elevator use of buildings, hail insurance, management, general farm expenses, and interest on seasonal growing costs or net costs. As pointed out above a high proportion of these costs are fixed in nature and constitute a levy even if no crop were harvested. It follows that the ultimate yield per acre is an important factor affecting cost per bushel. The data accumulated through varying periods of years on the station farms in Manitoba, Saskatchewan and Alberta is summarized in Figure 28 showing the effect of yield per acre on the cost per bushel laid down at country elevator point.

It is apparent that the critical level of wheat production has centered on a yield of 15·0 bushels per acre and where yields are below this level higher costs are recorded. This does not apply in all cases in that where yields have been between 10·0 and 15·0 bushels per acre costs per bushel on some stations were as high as $0.98 and on others as low as $0.52. Where crops have yielded in the range of 5·0 to 10·0 bushels per acre costs have ranged from a low of $0.76 per bushel to a high of $1.14. While higher yields have usually given lower costs per bushel the variation has been relatively wide . In the yield groups of 20·0 to 30·0 bushels per acre costs have ranged from a low of less than $0.40 per bushel to a high of $0.79 per bushel. Where land values are high land-use charges and taxes are also correspondingly high and increased yields must be acquired to compensate for these additional costs. In the more moist areas where several operations are required to maintain satisfactory summerfallows tillage costs tend to reduce the advantages which ordinarily accrue from higher yields. The extent and species of weed population is also an important factor affecting the cost of crop production. In the more diversified areas in the northern parts of the provinces smaller power units and smaller tillage implements tend to increase the time required for land preparation, seeding and harvesting. Under these conditions the amount of man labour expended on an acre of crop is comparatively high thus occasioning additional expense. Conversely in areas where land values are comparatively low and extensive operations with large machines are possible substantially lower yields have frequently been produced at a cost which allows for profitable operation.

FIELD DAYS

In view of the development of experimental work on each station along lines which 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 Division of Illustration Stations 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 sound 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 1938 to 1947 inclusive 1,425 field days were held on station farms and were attended by 176,030 farmers or an average of 123 per meeting. The largest attendance in any one year during the period was in 1939 when 25,604 persons attended organized field days to examine illustration station projects in the field.

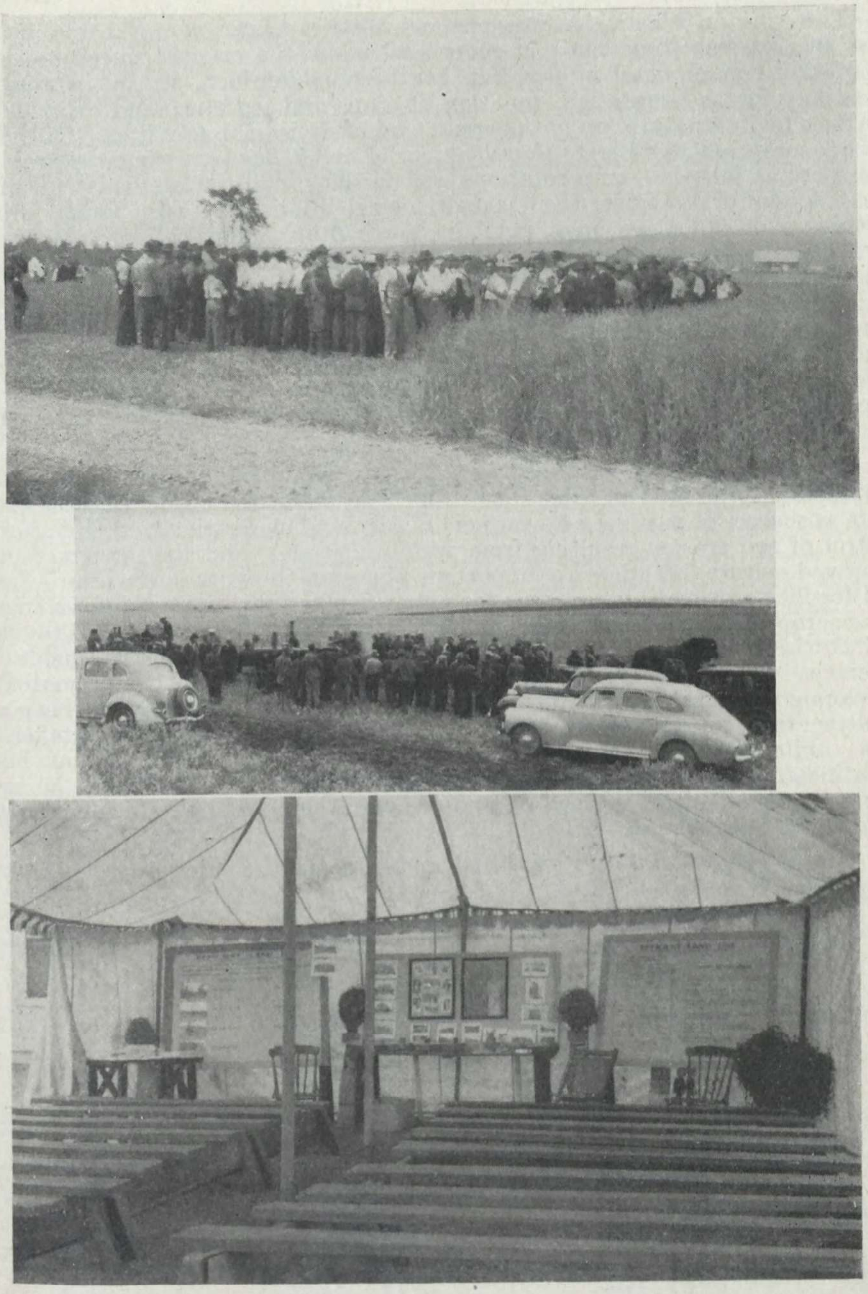


FIG. 29.—Field days provide an opportunity for farmers to view experimental work. (Top): Farmers examining cereal variety plots at a meeting held on the St. Edwidge, Que., Illustration Station in 1942.—(Middle): Tillage is important in Western Canada. Photo shows a field day group on the substation at Castor, Alta. (Bottom): The tent is up and exhibit material is in place in readiness for a New Brunswick field day (1939).

PROGRAM OF WORK

The work on Illustration Stations and District Experiment Substations has been progressively broadened in scope and while the original purpose of disseminating experimental information has been maintained, studies relating to cereal and forage adaptation, zonation of crops and varieties, and experiments of a fact finding nature are an inherent part of divisional activities. This field of work comprises 18 different classifications of well defined experimental projects. These are as follows,—crop rotations, soil fertility, cultural methods and practices, agricultural engineering, meteorological studies, cereals, forage crops, pastures, root and silage crops, potatoes, horticulture, industrial crop plants and special crops, livestock, fur bearing animals, apiculture, farm management, and publicity. Specific studies are allotted a project number within each classification with methods of procedure and analysis clearly defined. In certain experiments, more than one classification may be involved such as where fertility studies would be conducted within the structure of a specific rotational project. Such an experiment would permit the analysis of results to be made on the basis of response to fertilizer treatment, and also allow for an examination of the effect of crop sequence on soil productivity.

The production of improved varieties of cereals and forage crops, where adaptable, is promoted on these Illustration Station farms in order that they may serve as sources of pure seed for farmers in surrounding districts. Strip farming, control of soil erosion resulting from wind and water, and the introduction of improved cultural practices are important phases of the work in the prairie areas. Soil fertility experiments, contour farming, crop testing, pasture improvement, forage crop studies, and special crops are active projects in the Eastern Provinces and British Columbia and in those parts of the Prairie Provinces outside the specialized grain growing areas. Livestock policies designed to promote the development of improved herds of cattle and swine as well as flocks of sheep and poultry are an integral part of the farm improvement program undertaken on these units. Farm organization and management studies as well as home beautification are other projects designed to acquire information on the most economical methods of production and promote those features which contribute to financial effectiveness.

The Divisional projects are listed and indicate the supervisory district in which each is active.

LIST OF DIVISIONAL PROJECTS SHOWING THOSE ACTIVE IN EACH SUPERVISORY DISTRICT

Project No.	PROJECT TITLE	Charlottetown, P.E.I.	Nappan, N.S.	Kentville, N.S.	Fredericton, N.B.	Ste. Anne, Que.	Normandin, Que.	Lennoxville, Que.	Ottawa, W. Que.	Ottawa, E. Ont.	Mindemoya, Ont.	Kapuskasing, Ont.	Makamik, Que.	Fort William, Ont.	Brandon, Man.	Indian Head, Sask.	Melfort, Sask.	Snowden, Sask.	Swift Current, Sask.	Scott, Sask.	Loon Lake, Sask.	Lethbridge, Alta.	Lacombe, Alta.	Athabaska, Alta.	Beaverlodge, Alta.	McLennan, Alta.	Creston, B.C.	Agassiz, B.C.	Prince George, B.C.
	Rotations, East and British Columbia																												
IS-EI.31	Hoed Crop—Cereal (s)—Clover				x	x	x		x		x	x	x					x											
IS-EI.32	Cereal (s)—Clover—Timothy						x																						
IS-EI.41	Cereal—Cereal (s)—Clover—Hay or Pasture						x		x																				
IS-EI.42	Hoed Crop—Cereal (s)—Clover—Timothy	x		x	x	x		x	x	x	x	x		x														x	
IS-EI.43	Cereal (s)—Clover—Timothy—Timothy											x	x	x															
IS-EI.44	Hoed Crop—Hoed Crop—Cereal (s)—Clover								x				x																
IS-EI.45	Tobacco—Tobacco—Cereal—Clover								x																				
IS-EI.51	Hoed Crop—Cereal (s)—Clover—Timothy—Timothy	x	x		x			x	x	x	x	x																	
IS-EI.52	Hoed Crop—Cereal (s)—Clover—Timothy—Cereal																											x	
IS-EI.53	Cereal—Cereal (s)—Clover—Timothy—Timothy										x	x	x																x
IS-EI.54	Cereal (s)—Clover—Cereal (s)—Clover—Timothy					x	x																						
IS-EI.62	Hoed Crop—Cereal (s)—Clover—Timothy—Timothy or Pasture—Cereal	x			x					x																			
IS-EI.64	Hoed Crop—Cereal (s)—Clover—Hay—Hay—Hay or Pasture									x	x	x																	
IS-EI.65	Hoed Crop—Cereal (s)—Clover—Cereal (s)—Clover—Timothy								x																				
IS-EI.66	Partial Fallow (s)—Hay—Hay—Hay—Cereal—Cereal																											x	
IS-EI.81	Hoed Crop—Cereal (s)—Alfalfa—Alfalfa—Alfalfa—Alfalfa—Cereal—Cereal																											x	x
IS-EI.101	Hoed Crop—Alfalfa—Alfalfa—Alfalfa—Alfalfa—Alfalfa—Alfalfa—Alfalfa—Cereal—Cereal																											x	
	Rotations—West																												
IS-WI.21	Fallow—Wheat														x														
IS-WI.23	Wheat—Hay														x														
IS-WI.25	Corn—Wheat																			x									
IS-WI.31	Fallow—Wheat—Coarse Grain														x	x	x	x	x	x			x		x	x			
IS-WI.32	Fallow—Wheat—Wheat														x	x			x	x		x			x				
IS-WI.33	Fallow—Wheat—Hay															x		x		x			x		x	x			
IS-WI.34	Fallow—Coarse Grain—Coarse Grain															x													
IS-WI.35	Coarse Grain—Coarse Grain—Hay																											x	x
IS-WI.36	Wheat—Coarse Grain—Hay															x													
IS-WI.37	Fallow—Flax—Wheat																					x							
IS-WI.41	Fallow—Wheat—Wheat—Coarse Grain																x												
IS-WI.42	Fallow—Wheat—Coarse Grain—Hay																x												
IS-WI.43	Wheat—Coarse Grain—Coarse Grain—Hay (3 years)																x			x									
IS-WI.44	Fallow—Wheat—Hay—Coarse Grain														x	x									x				
IS-WI.45	Wheat—Coarse Grain—Hay—Hay																x												
IS-WI.47	Fallow—Grain—Hay—Corn														x														
IS-WI.51	Fallow—Wheat—Hay—Wheat—Coarse Grain															x													
IS-WI.52	Coarse Grain—Coarse Grain—Coarse Grain—Hay—Hay																						x						
IS-WI.53	Coarse Grain—Coarse Grain—Hay—Hay—Hay																						x						

LIST OF DIVISIONAL PROJECTS SHOWING THOSE ACTIVE IN EACH SUPERVISORY DISTRICT

Project No.	PROJECT TITLE	Charlottetown, P.E.I.	Nappan, N.S.	Kentville, N.S.	Fredericton, N.B.	Ste. Anne, Que.	Normandin, Que.	Lennoxville, Que.	Ottawa, W. Que.	Ottawa, E. Ont.	Mindemoya, Ont.	Kapuskasing, Ont.	Makamik, Que.	Fort William, Ont.	Brandon, Man.	Indian Head, Sask.	Melfort, Sask.	Snowden, Sask.	Swift Current, Sask.	Scott, Sask.	Loon Lake, Sask.	Lethbridge, Alta.	Lacombe, Alta.	Athabaska, Alta.	Beaverlodge, Alta.	McLennan, Alta.	Creston, B.C.	Agassiz, B.C.	Prince George, B.C.
	ROTATIONS—WEST—*Concluded*																												
IS-WI.54	Fallow—Wheat—Coarse Grain—Hay—Hay																x									x			
IS-WI.55	Fallow—Wheat—Hay—Coarse Grain—Coarse Grain															x													
IS-WI.56	Fallow—Wheat—Hay—Coarse Grain—Alfalfa five years																x												
IS-WI.61	Fallow—Wheat—Hay—Hay—Wheat—Coarse Grain														x		x	x											
IS-WI.62	Fallow—Wheat—Wheat—Fallow—Coarse Grain—Coarse Grain																								x				
IS-WI.63	Fallow—Wheat—Hay—Hay—Coarse Grain—Coarse Grain																x						x		x				x
IS-WI.64	Fallow—Wheat—Coarse Grain—Hay—Wheat—Coarse Grain																x												
IS-WI.66	Fallow—Wheat—Coarse Grain—Coarse Grain—Hay—Hay																			x									
IS-WI.69	Barley—Oats—Hay—Hay—Hay—Hay																											x	
IS-WI.71	Fallow—Wheat—Coarse Grain—Hay—Hay—Coarse Grain—Coarse Grain (seeded to Green Manure Crop)																x												
IS-WI.72	Fallow—Wheat—Wheat—Hay—Hay—Grain—Grain																								x				
IS-WI.81	Fallow—Wheat—Coarse Grain—Hay—Hay—Fallow—Wheat—Coarse Grain														x														
	SOIL FERTILITY																												
IS-02·01	Plant Food Deficiency Studies (Eastern)	x			x		x	x	x	x	x			x														x	x
IS-02·02	Plant Food Deficiency in Grey Wooded Soils																x	x		x			x		x	x		x	x
IS-02·03	Chemical Fertilizer as a Supplement to Farm Manure (Formulae test)	x		x	x	x	x	x	x	x	x	x		x														x	
IS-02.03B	Chemical Fertilizer as a Supplement to Farm Manure (Rate of application)	x	x	x	x	x	x	x	x		x	x	x															x	
IS-02.03C	Chemical Fertilizer as a Supplement to Farm Manure (Place in rotation when hoed crop grown)	x	x	x	x		x	x	x	x	x	x																x	
IS-02.03C-2	Chemical Fertilizer as a Supplement to Farm Manure (Place in grain rotation)		x	x		x		x	x	x	x	x		x														x	x
IS-02.03C-3	Chemical Fertilizer as a Supplement to Farm Manure (Place in rotation to apply manure)	x																											
IS-02.04	Chemical Fertilizer: Study of Formulae	x	x		x	x	x				x			x											x	x			
IS-02.05	Chemical Fertilizer: Study of Rates	x				x											x	x											
IS-02.06	Plant Food Deficiency Studies on Peat Soils									x													x						
IS-02.07	Utilization Farm Manure														x														
IS-02.08	The Effect of Ground Limestone on Farm Crops	x	x	x	x		x	x		x	x	x	x	x															
IS-02.09	Nitrogenous Fertilizers for Hay Lands	x	x																									x	
IS-02.10	The Effect of Chemical Fertilizers on Cereals	x													x	x			x	x		x	x				x	x	x
IS-02.11	Study of Effect of Trace Elements	x																									x		
IS-02.12	Root Fibre and Crop Residue in Soil Improvement	x													x	x				x		x	x						
IS-02.13	The Effect of Chemical Fertilizer on Yield of Beans																x												
IS-02.14	The Effect of Farmyard Manure and Chemical Fertilizers in Tobacco Production								x																				
IS-02.15	Orchard Fertility Investigations									x																			
IS-02.16	The Effect of Chemical Fertilizers on Cranberries	x																											

IS-02.17	Vegetable and Small Fruit Fertilizer Test									x							x										x		
IS-02.18	Comparison of Superphosphate with Other Carriers of Phosphorus		x	x			x		x																				
IS-02.19	Muriate Vs. Sulphate of Potash for Potatoes													x															
IS-02.20	Organic Matter, Study as to Maintenance and Increase				x	x																			x				
	Cultural Methods and Practices																												
IS-03.01	Control of Weeds by Cultural Methods				x	x	x	x	x	x	x	x	x	x	x	x	x	x		x		x	x		x			x	x
IS-03.02	Control of Weeds by Chemicals					x	x		x	x	x	x			x		x	x	x	x		x	x		x			x	x
IS-03.03	Contour Farming				x																	x							
IS-03.04	Study of Tillage Methods (Eastern)												x				x	x											
IS-03.05	Cultural Treatments for Summerfallow														x	x			x	x		x	x						
IS-03.06	Summerfallow Substitutes															x				x									
IS-03.07	Soil Moisture Studies in Relation to Crop Yields															x			x	x		x							
IS-03.08	Strip Farming as a Control Measure for Soil Drifting														x	x	x		x	x		x	x						
	Agricultural Engineering																												
IS-04.02	Water Development Studies															x			x	x		x	x		x				
IS-04.03	Improving Hygienic Conditions in Old Stables	x	x	x								x	x																
IS-04.04	Planning New Farm Buildings	x			x	x		x	x	x	x	x	x	x		x												x	x
IS-04.05	Water Erosion Control	x			x										x				x			x			x				
IS-04.07	Study of Irrigation Methods																										x		
IS-04.08	Whitewashing and Painting of Farm Buildings	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x			x			x	x
IS-04.10	Testing New Types of Equipment and Farm Machinery										x						x					x	x						
	Meteorological Studies																												
IS-05.01	Study of Regional Climatic Conditions as Related to Crop Production	x	x			x	x	x	x	x	x	x	x		x	x	x	x	x	x		x	x		x	x		x	x
IS-05.02	Records of Regional Precipitation	x	x	x		x	x	x	x		x	x	x	x	x	x	x	x	x	x		x	x		x	x	x	x	x
IS-05.03	Records of Regional Temperature	x									x			x			x	x		x			x		x	x	x		
	Cereals																												
IS-06.01	Rate of Seeding															x	x	x		x									
IS-06.02	Date of Seeding												x			x			x								x		
IS-06.03	Testing Cereals for Fall Sown Cover Crop																					x							
IS-06.04	Introducing Suitable Varieties of Cereals	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x					x		
IS-06.05	Testing Cereal Varieties	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x	x	x	x	x
IS-06.06	Production of Registered and Pure Seed Grain	x			x	x				x	x				x	x				x		x	x		x			x	x
IS-06.07	Testing Grain Mixtures													x															
IS-06.10	Winter Hardiness of Fall Seeded Grain												x	x					x	x		x	x				x	x	
IS-06.12	Testing Field Pea Varieties												x	x			x	x				x	x						
IS-06.13	Control of Wheat Stem Sawfly															x			x	x									
	Forage Crop Studies (Hay Crops)																												
IS-07.01	Testing Mixtures for Hay or Pasture	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x			x		x	x	x	x	
IS-07.02	The Effect of Grasses, Legumes and Chemical Fertilizer on Yield and Soil Improvement																x	x		x									
IS-07.03	Alfalfa Seed Set as Affected by Variety and by Environmental Conditions																								x	x			
IS-07.05	Methods of Growing Grass and Legume Hays														x	x				x					x				
IS-07.06	Varietal Test of Legumes as a Hay or Pasture Crop					x								x			x	x		x									
IS-07.07	Varietal Test of Grasses as a Hay or Pasture Crop													x						x									
IS-07.08	Methods of Producing Seed of Leguminous Plants						x		x	x	x	x	x		x								x		x			x	x
IS-07.09	Methods of Producing Seed of Grass Plants								x	x	x	x				x													
IS-07.10	Inoculation Vs. Non-inoculation of Legumes												x										x						
IS-07.11	Adaptation of Different Grass and Clover Species Sown on Slough Land																												

LIST OF DIVISIONAL PROJECTS SHOWING THOSE ACTIVE IN EACH SUPERVISORY DISTRICT

Project No.	PROJECT TITLE	Charlottetown, P.E.I.	Nappan, N.S.	Kentville, N.S.	Fredericton, N.B.	Ste. Anne, Que.	Normandin, Que.	Lennoxville, Que.	Ottawa, W. Que.	Ottawa, E. Ont.	Mindemoya, Ont.	Kapuskasing, Ont.	Makamik, Que.	Fort William, Ont.	Brandon, Man.	Indian Head, Sask.	Melfort, Sask.	Snowden, Sask.	Swift Current, Sask.	Scott, Sask.	Loon Lake, Sask.	Lethbridge, Alta.	Lacombe, Alta.	Athabaska, Alta.	Beaverlodge, Alta.	McLennan, Alta.	Creston, B.C.	Agassiz, B.C.	Prince George, B.C.
	FORAGE CROP STUDIES—HAY CROPS—*Continued*																												
IS-07.12	Leguminous and Non-Leguminous Hay Crops on Peat Soil											x																	
IS-07.13	Adaptation of Grasses and Legumes to Varying Regional Conditions												x		x	x			x			x							
IS-07.14	Cereal Hay Test																												
	PASTURE INVESTIGATIONAL STUDIES																												
IS-08.01	Chemical Fertilizers for Pasture; Study of Rates			x		x																							
IS-08.02	Chemical Fertilizers for Pasture; Study of Formulae	x	x		x	x	x	x	x	x	x	x	x	x														x	
IS-08.03	Manure Vs. Chemical Fertilizer for Pasture	x																											
IS-08.04	Continuous Permanent Pasture Vs. Pasture in Rotation																												
IS-08.05	Annual Pasture																												
IS-08.06	Pasture Seeding and Management Studies				x			x					x		x	x	x			x		x	x				x		
IS-08.09	Rejuvenation of Old Pastures by Chemical Fertilizers																												
	ROOT AND SILAGE CROPS																												
IS-09.01	Corn Growing for Seed and Forage					x	x								x	x													
IS-09.02	Field Corn Variety Test	x				x			x	x	x	x		x														x	
IS-09.03	Oats, Peas and Vetches as a Hay and Silage Crop											x	x																
IS-09.05	Club Root Studies in Turnips			x																									
IS-09.06	Methods of Controlling Brown Heart in Turnips	x	x	x	x	x	x		x		x	x	x	x														x	
IS-09.07	Methods of Growing Root Crops												x																
IS-09.08	Turnip and Mangel Growing			x																									
IS-09.10	Making Grass and Legume Silage			x	x																								
IS-09.11	Methods of Growing Turnip and Mangel Seed																												
IS-09.12	Turnip Variety Test	x				x		x			x	x	x	x															
IS-09.13	Mangel Variety Test													x															
	POTATO PRODUCTION STUDIES																												
IS-10.01	Growing Certified Seed Potatoes	x			x		x			x																			
IS-10.02	Growing Tuber Unit Seed Potatoes in Isolated Plots	x			x	x	x			x																			
IS-10.03	Introducing Suitable Varieties of Potatoes				x					x			x		x	x	x	x		x							x		
IS-10.05	Potato Variety Test										x	x	x	x		x	x			x							x		
IS-10.06	Potato Disease and Insect Control						x	x			x	x	x	x														x	
IS-10.07	Study of Crop Sequence and Cover Crops for Potatoes			x			x																						
	HORTICULTURE																												
IS-11.02	Stimulating Interest in the Development of the Farm Garden	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x			x	x
IS-11.03	The Establishment of a Farm Orchard	x		x	x	x			x	x				x	x	x	x	x	x	x			x		x			x	x
IS-11.05	Orchard Cover Crop																										x		
IS-11.06	Fruit Tree Root and Framework Stock Test				x																						x		
IS-11.07	Tree Fruit Variety Test												x	x		x											x		
IS-11.08	Garden Vegetable Variety Test									x			x	x								x					x		x
IS-11.09	Small Fruits Variety Test	x												x	x	x			x									x	
IS-11.10	The Study of the Production of Vegetable Seeds																												x

IS-11.11	*Strawberry Improvement Study*																									x		
IS-11.13	*Market Trials (Green Peas)*																									x		
IS-11.14	Investigation and Control of Vegetable Diseases					x																						
IS-11.17	Farm Home Beautification	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x		x	x	x
IS-11.18	Farm Shelter Belts				x									x	x	x	x	x		x		x	x		x				
IS-11.20	Growing Bulbs																												
	Industrial Plants and Special Crops																												
IS-12.01	Soybean Variety Test										x			x													x		
IS-12.02	Flax Variety Test								x					x		x	x	x	x	x		x					x		
IS-12.03	Study of Flax Production								x										x	x							x		
IS-12.05	Methods of Cultivating and Training Hops									x																			
IS-12.06	Studies of Insect Control Concerning Hops									x																			
IS-12.07	Investigation of Disease Occurrence and their Control in Hops									x																			
IS-12.08	Study of the Effects of Manure and Chemical Fertilizers on Hop Yields									x																			
IS-12.09	Sugar Beet Production								x																				
IS-12.10	Field Beans; Variety Test																										x		
IS-12.11	Blueberry Production Studies	x																											
IS-12.14	Methods of Control of Cranberry Insects	x																											
IS-12.16	Methods of Weed Control on Cranberry Bogs	x																											
IS-12.17	Cranberry Production on Upland Areas	x																											
IS-12.18	Cranberry Variety Test			x																									
IS-12.19	Sunflower Variety Test (Oil Production)																												
	Livestock																												
IS-13.01	Dairy Cattle Production	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x						x					x	x
IS-13.03	Animal Pathological Records	x				x	x	x	x	x	x	x	x																
IS-13.05	Sales of Livestock for Breeding Purposes	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x		x	x		x			x	x
IS-13.06	Beef Production	x									x			x	x	x			x	x		x	x		x			x	x
IS-13.07	Swine Production	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x			x	x
IS-13.08	Sheep Production	x	x	x	x	x	x	x	x	x	x	x		x									x					x	
IS-13.09	Study of Horse Breeding						x																						
	Poultry																												
IS-14.01	Poultry Production	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x			x	x
IS-14.04	Sale of Hatching Eggs, Pullets and Cockerels for Reproduction	x	x		x	x				x		x	x	x	x	x	x		x			x	x		x				
	Apiculture																												
IS-16.02	Records and Studies of Honey Production	x											x	x		x													
	Farm Management																												
IS-17.01	Yield and Cost of Producing Farm Crops														x	x	x	x	x	x		x	x		x				
IS-17.02	Cost of Producing Milk		x	x	x	x	x	x	x		x	x		x														x	
IS-17.03	Studies of Various Defects in Regional Farming (Study of Farm Productivity and Progress)	x	x	x	x	x	x	x	x		x	x	x	x		x	x	x	x	x		x	x		x			x	x
IS-17.04	Study of Farm Business	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x			x	x
IS-17.07	Establishment of Feed and Seed Reserves														x	x	x	x	x	x		x	x						
IS-17.09	Management of the Farm Woodlot	x			x																								
	Publicity																												
IS-19.01	Field Days	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x		x	x	
IS-19.02	Publications and Presentation of Results	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x		x	x	x

x indicates the district or districts in which each project is established and being actively conducted.

EXPERIMENTAL FARMS SERVICE

DIRECTOR, E. S. ARCHIBALD, B.A., B.S.A., LL.D., D.Sc.
ASSOCIATE DIRECTOR, E. S. HOPKINS, B.S.A., M.Sc., Ph.D.

Dominion Field Husbandman	P. O. Ripley, B.S.A., M.Sc., PhD.
Dominion Horticulturist	M. B. Davis, B.S.A., M.Sc.
Dominion Cerealist	C. H. Goulden, B.S.A., M.S.A., Ph.D.
Dominion Animal Husbandman	G. W. Muir, B.S.A.
Dominion Agrostologist	T. M. Stevenson, B.S.A., M.Sc., Ph.D.
Dominion Poultry Husbandman	H. S. Gutteridge, B.S.A., M.Sc.
Chief, Tobacco Division	N. A. MacRae, B.A., M.Sc., Ph.D.
Dominion Apiculturist	C. A. Jamieson, B.S.A.
Chief Supervisor of Illustration Stations	J. C. Moynan, B.S.A.
Economic Fibre Specialist	R. J. Hutchinson.

PRINCE EDWARD ISLAND

Superintendent, Experimental Station, Charlottetown, R. C. Parent, B.S.A., M.Sc.
Superintendent, Experimental Fox Ranch, Summerside, G. K. Gunn, B.Sc., M.Sc., Ph.D.

NOVA SCOTIA

Superintendent, Experimental Farm, Nappan, W. W. Baird, B.S.A.
Superintendent, Experimental Station, Kentville, A. Kelsall, B.S.A.

NEW BRUNSWICK

Superintendent, Experimental Station, Fredericton, S.A. Hilton, B.S.A., M.S.A.

QUEBEC

Superintendent, Experimental Station, Lennoxville, J. A. St. Marie, B.S.A.
Superintendent, Experimental Station, Ste. Anne de la Pocatiere, J. R. Pelletier, B.S.A., M.A., M.Sc.
Superintendent, Experimental Station, L'Assomption, R. Bordeleau, B.S.A.
Superintendent, Experimental Station, Normandin, A. Belzile, B.S.A.
Officer-in-Charge, Experimental Substation, Ste. Clothilde, F. S. Browne, B.S.A.

ONTARIO

Central Experimental Farm, Ottawa.
Superintendent, Experimental Station, Kapuskasing, F. X. Gosselin, B.S.A.
Superintendent, Experimental Station, Harrow, H. F. Murwin, B.S.A.
Officer-in-Charge, Experimental Substation, Delhi, L. S. Vickery, B.S.A., M.Sc.
Officer-in-Charge, Experimental Substation, Smithfield, D. S. Blair, B.S.A., M.Sc.

MANITOBA

Superintendent, Experimental Farm, Brandon, R. M. Hopper, B.S.A., M.Sc.
Superintendent, Experimental Station, Morden, W. R. Leslie, B.S.A.
Officer-in-Charge, Pilot Flax Mill, Portage la Prairie, E. M. MacKey, B.S.A.

SASKATCHEWAN

Superintendent, Experimental Farm, Indian Head, J. G. Davidson, B.A., B.S.A., M.S.A.
Superintendent, Experimental Station, Scott, G. D. Matthews, B.S.A.
Superintendent, Experimental Station, Swift Current, G. N. Denike, B.S.A.
Superintendent, Experimental Station, Melfort, H. E. Wilson, B.S.A.
Superintendent, Experimental Substation, Regina, J. R. Foster, B.S.A.
Superintendent, Forest Nursery Station, Indian Head, John Walker, B.Sc., M.S.
Superintendent, Forest Nursery Station, Sutherland, W. L. Kerr, B.S.A., M.Sc.

ALBERTA

Superintendent, Experimental Station, Lacombe, G. E. DeLong, B.S.A., M.Sc.
Superintendent, Experimental Station, Lethbridge, A. E. Palmer, B.Sc., M.Sc.
Superintendent, Experimental Station, Beaverlodge, E. C. Stacey, B.A., M.Sc.
Officer-in-Charge, Range Experiment Station, Manyberries, H. F. Peters, B.S.A.
Officer-in-Charge, Experimental Substation, Fort Vermilion, V. J. Lowe.

BRITISH COLUMBIA

Superintendent, Experimental Farm, Agassiz, W. H. Hicks, B.S.A.
Superintendent, Experimental Station, Summerland, R. C. Palmer, B.S.A., M.Sc., D.Sc.
Superintendent, Experimental Station, Prince George, F. V. Hutton, B.S.A.
Superintendent, Experimental Station, Saanichton, J. J. Woods, B.S.A., M.S.A.
Superintendent, Experimental Substation, Smithers, W. T. Burns, B.S.A., M.Sc.
Officer-in-Charge, Range Experiment Station, Kamloops, T. G. Willis, B.S.A., M.S.A.

YUKON AND NORTHWEST TERRITORIES

Officer-in-Charge, Experimental Substation, Whitehorse, Y.T., J. W. Abbott.
Officer-in-Charge, Experimental Substation, Fort Simpson, N.W.T., J. A. Gilbey, B.S.A., M.Sc.

OTTAWA
EDMOND CLOUTIER, C.M.G., B.A., L.Ph.,
KING'S PRINTER AND CONTROLLER OF STATIONERY
1950