CANADA
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS SERVICE

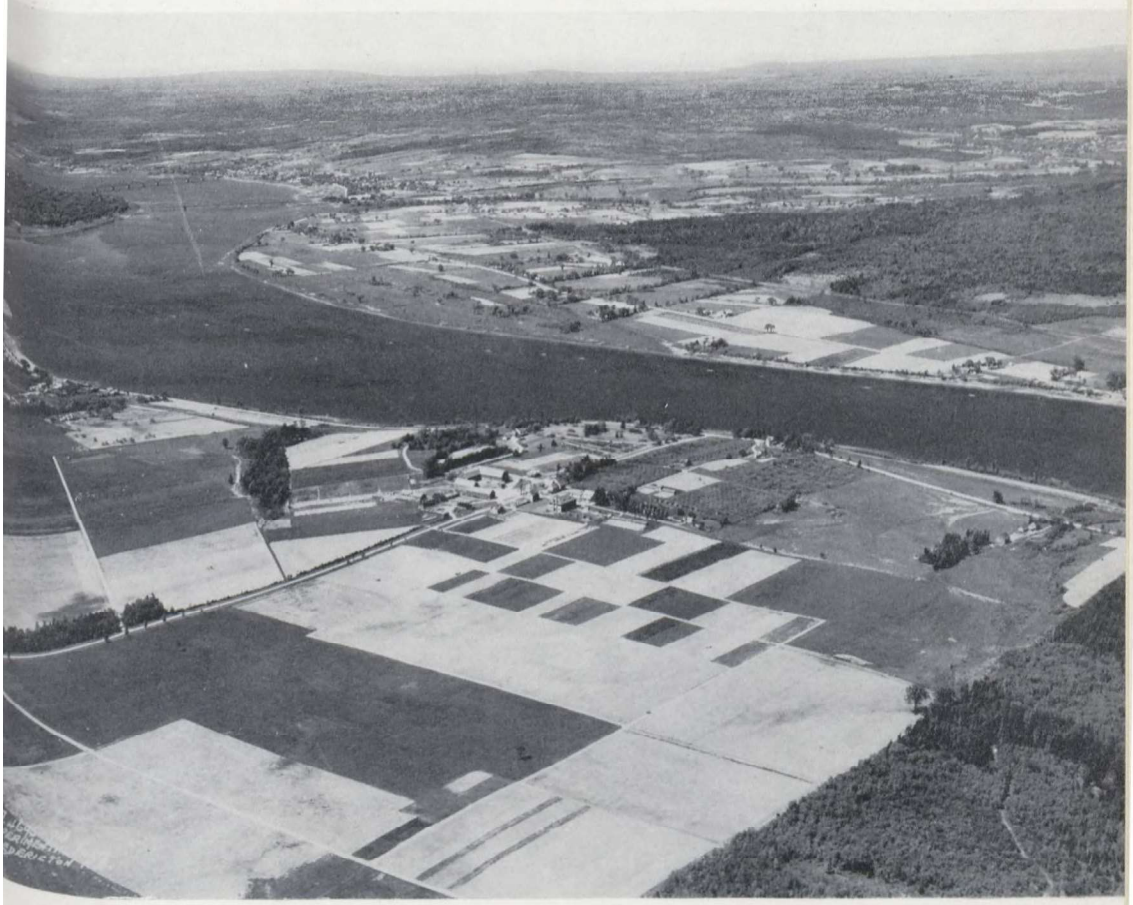
DOMINION EXPERIMENTAL STATION

FREDERICTON

N.B.

S. A. HILTON, B.S.A., M.Sc. (Agr.) SUPERINTENDENT

PROGRESS REPORT
1937-1947



AERIAL VIEW OF
EXPERIMENTAL STATION
FREDERICTON, N.B.

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DOMINION EXPERIMENTAL STATION
FREDERICTON, N.B.

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INTRODUCTION

In 1912 the Dominion Experimental Station was established at Fredericton for the purpose of investigating problems peculiar to New Brunswick agriculture.

The work has developed over the years and by the end of 1947 the Experimental Farms Service was conducting experimental projects in many sections of the province. In addition to the Station at Fredericton, comprising six hundred and twenty acres, work was under way on a Horticulture Substation at MacDonald's Corner, Queen's county, purchased in 1946, as well as on fourteen Illustration Stations in widely separated districts in the province. Potato and grain yield trials were conducted on six private farms and soil fertility experiments on five private farms in 1947. A potato Isolation Station is maintained at Alma, Albert county, where some 10,000 lots of seedling potatoes were produced last year.

The Illustration Stations are located on privately-owned farms and play a dual role. They bring to the farmer the practical findings of the Experimental Station and they serve as testing grounds for new varieties of farm crops, cultural methods and soil treatments. In this latter role they are becoming increasingly important because of greater recognition being given to the fact that wide variations exist in soils and climatic conditions within the province.

The greater part of the labour involved in carrying out the program on the Illustration Stations is done by the operators. Without their co-operation the value of these stations would be greatly reduced.

Reports covering the work of the Station were published annually until 1930. In 1936, a five-year progress report was published, but World War II interferred with the 1941 publication.

This report covers the twelve-year period 1936 to 1947 inclusive. It is impossible to cover in detail all research work conducted during this period, but summaries are given and recommendations are made whenever warranted by the results obtained.

Since the primary objective of this report is to acquaint the farmer and the extension worker with the latest information on the many problems under study, details as to procedure and technique are omitted. These are available on application.

Suggestions will be greatly appreciated from readers of this report as to ways and means of improving future publications of this nature in order that they may be of greatest value possible to the farming industry.

The writers of this report wish to pay tribute to the two former Superintendents of this Station, W. W. Hubbard, 1912-1922 and C. F. Bailey, 1922-1947 and to R. C. Parent, Supervisor of Illustration Stations, 1936-1947. The work reported herein was conducted under Mr. Bailey's direction, and his wise counsel and guidance in the development of the Station are greatly appreciated.

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LIVESTOCK

Leonard Griesbach and S. A. Hilton

Line-Breeding Percheron Horses Gives Results

Some fifteen to twenty years ago, two Percherons were developed in the U.S.A. that proved to be outstanding progenitors of high class horse flesh. These were the stallion Laet and the mare Coreen. In 1936, a Percheron stud was established at this Station. Four brood mares were transferred from the Dominion Experimental Station, Ste. Anne de la Pocatière. These were all in foal to Black Diamond [14826], a son of Coreen. From these, two mares were raised and the present stud has been developed from this female foundation.

The line-breeding program has been based on the blood of the stallion Laet and the mare Coreen, as illustrated in Figure 1.

These stallions have been available for service to both grade and purebred mares throughout the province under the Premium Mare Policy. In order to encourage the breeding of good draft horses, sound purebred mares of desirable type are bred free of charge and a fee of only five dollars is charged for grades. There has been a falling off in number of mares bred, due to transportation difficulties during the war and to the increased use of power machinery, which has caused a general lack of interest in horse breeding. The peak in horse breeding was reached in 1941, when seventy mares were bred from widely separated sections of the province, while in 1947 the number of services totalled only seventeen.

Feed Requirements for Draft Colts

Feed consumption records of eighteen Percheron colts reared at this Station from 1939 to 1947 were compiled. These data as given in Table 1 may be used to determine the feed cost in any locality by applying local prices.

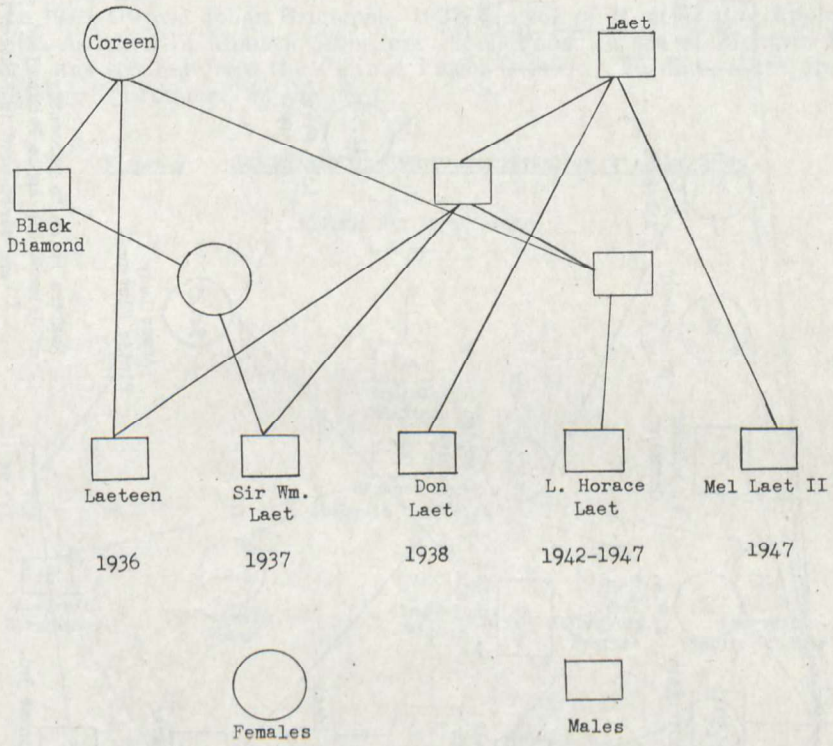
TABLE 1.—AVERAGE FEED CONSUMPTION OF ONE COLT—1939-1947

Period	Hay	Pasture	Oats	Bran
	tons	days	lb.	lb.
Weaning to 1 year of age	·73	45	917	233
1 year to 2 years of age	1·74	133	1,764	328
Total—weaning to 2 years of age	2·47	178	2,681	561

"Rag Apple" Breeding, the Foundation of the Holstein Herd

The Holstein-Friesian herd of about fifty head has been bred up to its present high standard in a comparatively few years. Line-breeding of the "Johanna Rag Apple Pabst" strain has been followed since 1938, when a young bull, Montvic Rag Apple Joe 123825, was obtained from T. B. Macauley, Mount Victoria Farms, Hudson Heights, Quebec. This bull which was sired by Montvic Pathfinder, left a large number of strong well balanced cows carrying good udders. His index, based on the first thirteen daughter-dam records is 12471 pounds milk, 3·61 per cent fat. The next bull used was Silver Acres King Pabst Segis 110106, a double great grandson of Montvic Rag Apple Pabst. This bull further improved the type and uniformity of the herd, which at the present time includes twenty of his daughters.

Figure 1 - DIAGRAM OF THE PERCHERON LINE-BREEDING POLICY, 1936-1947



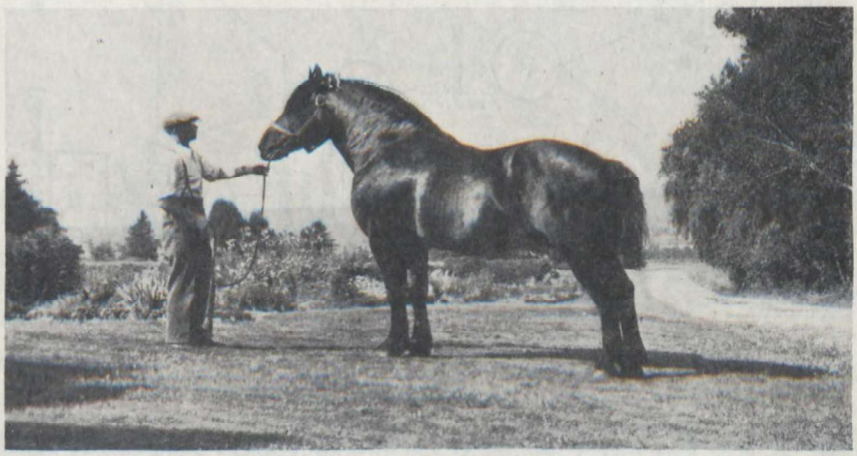


Figure 2—Lethbridge Horace Laet, Percheron Sire at Fredericton. 1942-1947

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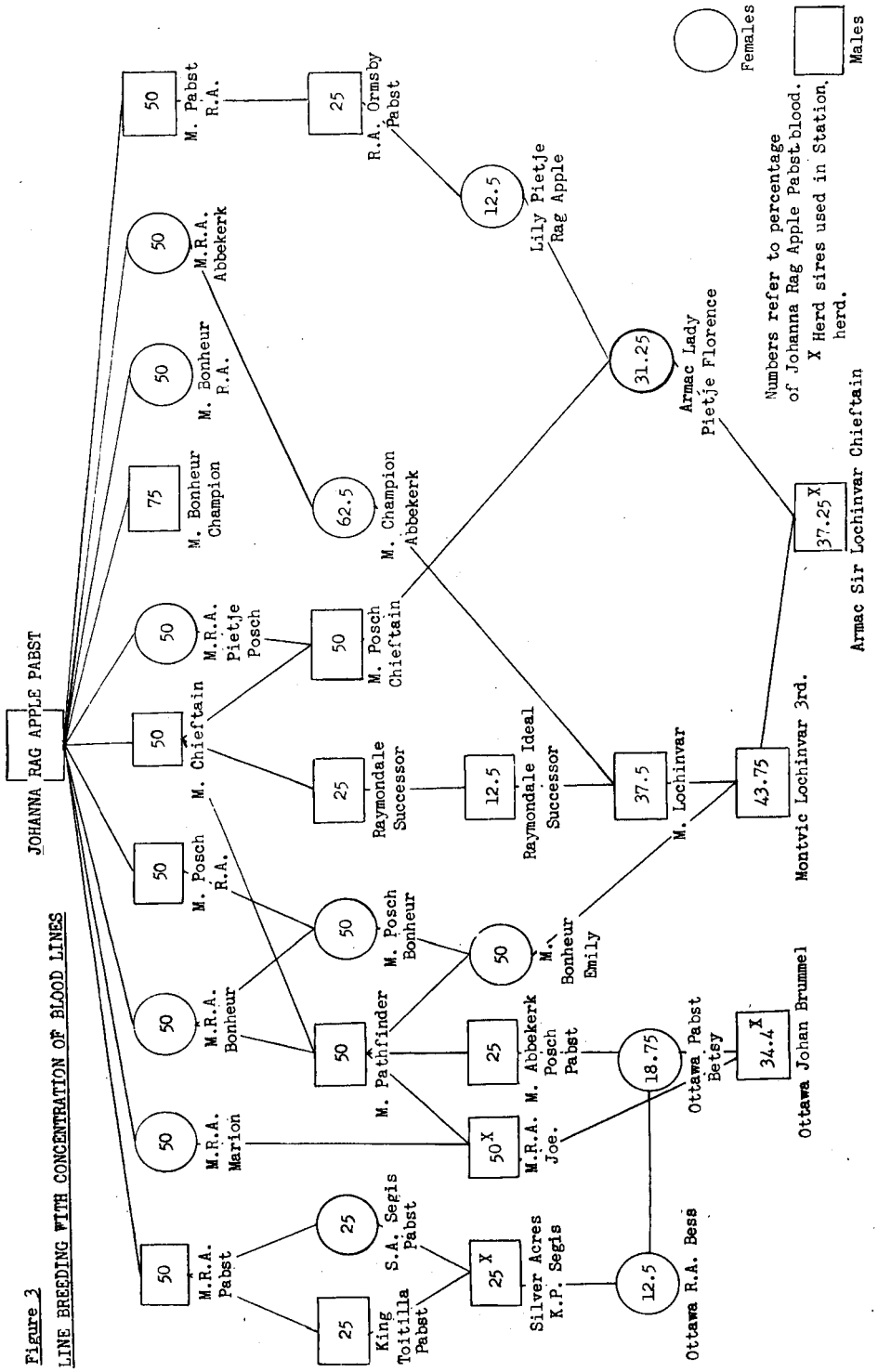


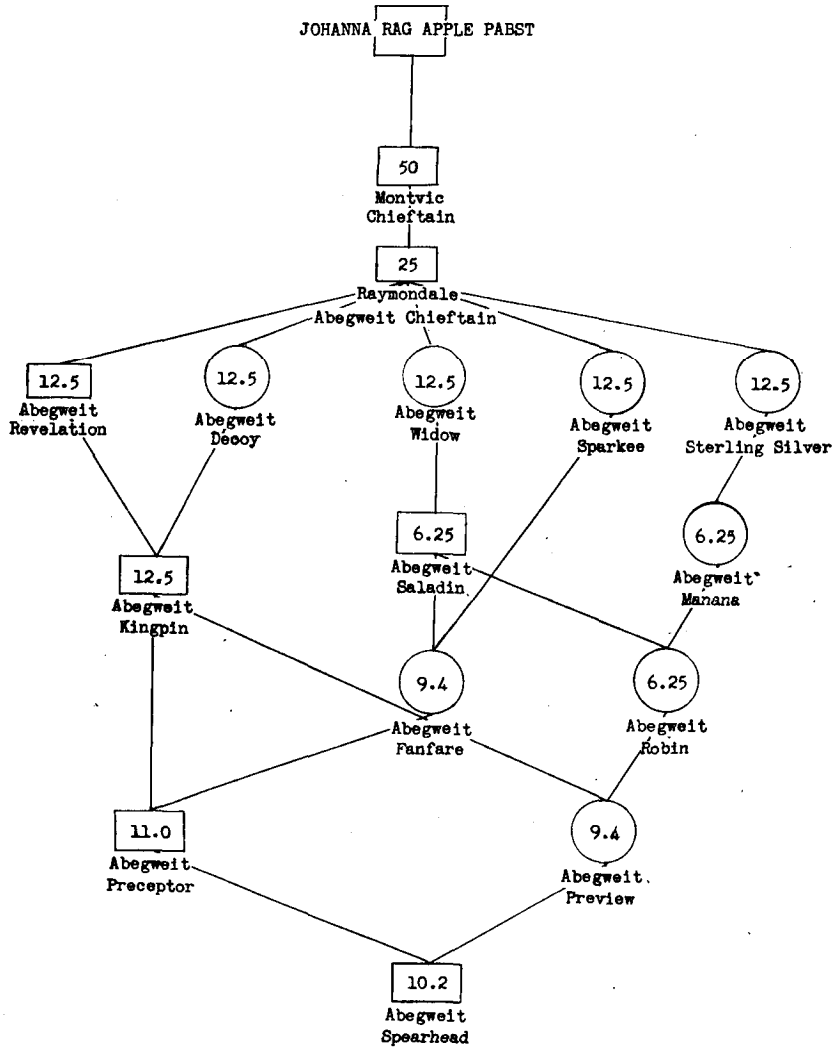
Figure 3

LINE BREEDING WITH CONCENTRATION OF BLOOD LINES

For a short period in 1945 and 1946, the bull Abegweit Spearhead was used pending the choice of another Rag Apple bred bull. There are now nine daughters by this bull in the herd.

In 1946, Ottawa Johan Brummel—192773, a son of Montvic Rag Apple Joe, out of a daughter of Montvic Abbekerk Posch Pabst (a son of Montvic Pathfinder), was secured from the Central Farm, Ottawa. To date, there are five daughters of "Brummel" in the herd.

Figure 4 LINE-BREEDING WITHOUT CONCENTRATION OF BLOOD-LINES



In 1947, the services of Armac Sir Lochinvar Chieftain—182071 were obtained through the co-operation of the Dominion Production Service and the Fredericton Artificial Breeding Unit. This bull is of excellent conformation and carries 37·25 per cent of the blood lines of Johanna Rag Apple Pabst.

The line-breeding program that is being followed in this herd is outlined in Figure 3. This Figure shows how the "blood" of Johanna Rag Apple Pabst is concentrated through the use of sires tracing directly to this bull through several lines. For example, Armac Sir Lochinvar Chieftain traces to him eleven times, through eight of his progeny and carries 37·5 per cent of his "blood". In contrast to this, Abegweit Spearhead, see Figure 4, a closely bred bull, traces five times to Johanna Rag Apple Pabst, all through one grandson but carries only 10·2 per cent of his blood. The early dissipation of the blood lines without further concentration through other close descendants resulted in a low concentration in "Spearhead".

By the use of sires carrying thirty per cent or more of "Rag Apple" breeding, it is possible to develop and hold a relatively high concentration of this line and, by careful selection, build up herds of high standard of uniformity, both in type and production. One or two out-crosses, however, will reduce the

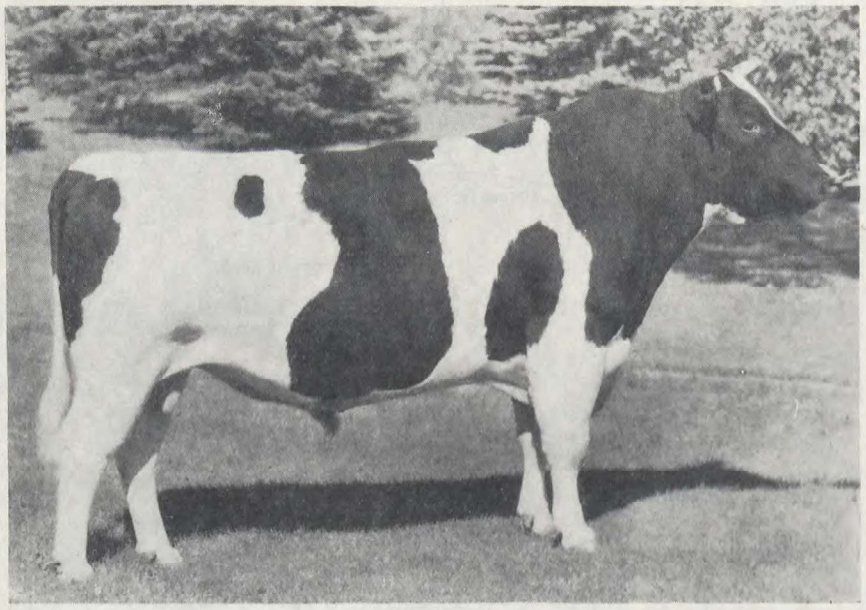


Figure 5—Montvic Rag Apple Joe 123825.

concentration to a point where it is difficult to regain its former high degree. For example, "Spearhead" bred to daughters of "Joe" resulted in a decrease in the "Rag Apple" blood lines to 17·6 per cent in the progeny. Armac Sir Lochinvar Chieftain, on the other hand, mated with the same females increases it to 31·25 per cent.

A sound line-breeding program, coupled with careful selection, is the foundation of the outstanding Holstein herds of today, and the majority of these are concentrating on the blood lines of Johanna Rag Apple Pabst.

Show-Ring Records

The quality and uniformity of the herd is recognized throughout the province, and visitors are invariably impressed with the improvement that has been made in recent years. In order to measure the effectiveness of the breeding program being carried on from the standpoint of type, an entry was

Figure 6—Daughters of Silver Acres King Pabst Segis in fertilized pasture.

made in the 1946 New Brunswick Provincial Holstein show. All of the cows in the herd had been milking for a considerable length of time, so the entry was confined to seven heifers ranging from senior heifer calves to two-year olds, and a junior yearling bull, Ottawa Pabst Colanthus Abbekerk. The winnings were as follows:—

Junior yearling bulls—First
Senior heifer calf—First and Reserve Junior Champion
Junior yearling heifer—First
Senior yearling heifer—First and Junior Champion
Dry 2-year old—First and Reserve Grand Champion
Get of sire—First—by Silver Acres King Pabst Segis
Progeny of dam—First

Feed Cost of Rearing Holstein Heifers

The average feed consumption from birth to one year, from one to two years and from two years to six to eight weeks before calving of 73 Holstein heifers during the ten-year period 1936 to 1945 inclusive is shown in Table 2.

TABLE 2.—AVERAGE FEED CONSUMPTION FOR 73 HOLSTEIN HEIFERS

Kind of Feed	Period Birth to one year	Period One to two years	Period Two years to 6-8 weeks before calving	Total from Birth to 6-8 weeks before calving
Average Age end of Period	1 year	2 years	2 years 8 months	2 years 8 months
Whole milk pounds	387	.....	.....	387
Skim-milk pounds	3,161	8	.....	3,169
Fat substitute pounds	220	0·6	.....	220·6
Dry meal pounds	849	100	26	975
Ensilage pounds	894	2,159	1,020	4,073
Hay pounds	1,755	2,851	1,252	5,858
Roots pounds	779	1,318	285	2,382
Pasture days	11	150	112	273

The plan used in raising these heifers is as follows. Calves are removed from their dams immediately after birth and taught to drink whole milk at the rate of twelve pounds daily for one month. Skim-milk with a scalded fat substitute consisting of four parts ground oats and one part ground flaxseed is then fed at the rate of about fourteen pounds daily until the calves are six

to eight months old. This varied according to the growth and condition of the calf. Good quality mixed hay and silage together with a meal mixture of two parts crimped oats, two parts bran and one part oil-cake meal are fed as soon as the calves will eat them. Most of the silage has been clover and grass while the roots fed were mostly swede turnips or mangels.

The value placed on feeds, especially hay, roots and silage varies widely in different districts. However, the application of local prices to the feeds shown in the table should give a fair estimate of the feed cost of rearing Holstein heifers in any locality.

Feeding Value of Clover Silage

The feeding value of clover silage was investigated in an experiment conducted in 1946 and again in 1947. The cows used for the experiment were divided into two groups and each group remained on its respective ration throughout the test. Those getting hay only as roughage were given two pounds of hay daily for each one hundred pounds live weight and the others were given one pound of hay and three and one-half pounds clover silage for each one hundred pounds of live weight. Each group received the same amount of grain.

The chemical analysis of the feeds used in 1946 was furnished by the Division of Chemistry, Science Service, and is shown in Table 3.

TABLE 3.—COMPOSITION OF FEEDS

Feed	Per Cent Composition of Air-Dry Material					
	Moisture	Ash	Fat	Protein (N × 6·25)	Crude Fibre	N-Free Extract
Hay	6·24	4·02	1·26	7·20	33·20	48·08
Clover silage	4·44	6·12	2·31	11·14	31·40	44·60
Grain	8·73	4·91	8·08	16·95	9·20	52·13

Note.—The moisture content of the original silage, when fed, was 75·04 per cent.

There was very little difference between the two groups in milk and butterfat production. In these tests, dry matter in the form of either silage or hay appeared of equal value even though the air-dry silage contained 3·94 per cent more protein than the hay. For practical purposes, it would appear that a succulent feed is not necessary for dairy cattle producing about 1,200 pounds of milk or forty-two pounds of butterfat a month and the relative importance of silage and hay is therefore determined largely by cost of production per ton of dry matter. However, the production of clover silage makes it possible to harvest clover in weather unsuitable for hay-making, and for this reason many dairymen, especially in coastal areas prize clover silage very highly.

Swine Breeding of Major Importance

Advanced Registry has been featured in the swine breeding work at this Station since 1929 and only sows which qualified in the test were retained for the production of breeding stock for sale. Considerable difficulty has been experienced by many breeders in recent years in obtaining litters free from ruptures, ridglings and hermaphrodites. The development of suitable strains, free from these defects and possessing desirable bacon type, is of prime importance.

With this as one the major objectives in view, the swine breeding program was re-organized in 1947. Two inbred lines developed at the Experimental Farm, Nappan, were transferred to this Station for further testing. Three sows and a boar from one of the best strains in Prince Edward Island were also secured. These lines will be developed by inbreeding and line-breeding and all litters will be tested under the Advanced Registry Policy. By careful selection, it is hoped that superior lines may be developed that will be of value in improving the breeding stock in the province.

In addition to the above, this Station is one unit in the Dominion-wide project designed to study the inheritance of factors which influence feeding efficiency and carcass quality. Five sows and two boars are at present being retained in the herd for this study.

Potatoes—A Valuable Feed for Bacon Hogs

Feeding experiments with rations made up largely of home-grown feeds have been carried on with bacon hogs since 1933. Investigations up to 1937 indicated that either skim-milk or fishmeal is an excellent protein supplement for home-grown feeds when fed to bacon hogs. It was also shown that raw potatoes and ground dried potatoes were unpalatable, and while fairly good results were obtained with these feeds in some tests, they could not be generally recommended for hog feeding purposes. Cooked potatoes proved to be a valuable feed, and experiments with potato silage gave promising results. During the next few years, rather extensive tests involving sixty hogs were made with potato silage.

Method of Feeding

In these experiments, the grain mixture for the check pen consisted of equal parts of ground oats, ground barley and middlings. After the pigs weighed about one hundred pounds each, one extra part of ground barley was added to the mixture. When skim-milk was used as the protein supplement, it was fed at the rate of two pounds of milk to one pound of grain at the beginning and one pound of milk to one pound of grain in the finishing period. When white fishmeal was used as the protein supplement, it was fed at the rate of ten per cent of the grain mixture at the beginning and reduced to five per cent during the finishing period. The mineral mixture, which was fed at the rate of two per cent of the meal mixture, was made up of forty pounds ground limestone, forty pounds bone char or bonemeal, and twenty pounds iodized salt. Each pig was given a tablespoonful of cod liver oil daily until a weight of about one hundred pounds was reached.

When potatoes were included in the ration, they replaced barley at the rate of 450 pounds of potatoes for each one hundred pounds of barley. The amount of potato silage fed was reduced according to its dry matter content.

The raw potato silage was made by mixing five per cent of moist fermented cornmeal with raw sliced potatoes and packing in a trench silo. The cooked potato silage was made by cooking potatoes with steam in puncheons and packing them in a trench silo. Both kinds of silage were examined again two years after ensiling and there was no appreciable change in palatability or chemical composition.

The chemical analysis of the potatoes and potato silage as determined by the Chemistry Division, Science Service, and the results of these experiments, are summarized in Tables 4 and 5.

TABLE 4.—CHEMICAL ANALYSIS OF POTATOES AND POTATO SILAGE

Material	Original Material					
	Moisture	Protein (N × 6·25)	Fat	Carbo-hydrates	Fibre	Ash
	%	%	%	%	%	%
Fresh potatoes	75·00	2·00	0·05	21·47	0·46	1·02
Cooked potato silage	75·02	2·33	0·05	20·10	0·75	1·75
Raw potato silage	55·60	2·13	0·40	38·74	1·31	1·82
	Water-Free					
Fresh potatoes	.....	8·01	0·19	85·87	1·83	4·10
Cooked potato silage	.....	9·31	0·25	80·50	2·96	6·98
Raw potato silage	.....	4·79	0·91	87·24	2·95	4·11

Summary of Results

The results of experiments up to 1940 indicated that cooked potato silage was a satisfactory feed for market hogs. Raw potato silage was not very palatable but was improved in this respect by cooking it as it was fed. Because of the difficulty of cooking potatoes for ensiling, work during the next two years was confined to tests with raw potato silage, cooked before feeding, with different supplements and with various proportions of meal.

Good results were obtained when raw potato silage was cooked, and fed with about an equal amount of grain and a protein supplement. However, silage made from raw potatoes suffers from the same limitations to its use as the raw potatoes, except that they can be preserved for feeding over a longer period and the trouble of removing sprouts is eliminated. The main objection to making cooked potato silage is that a steam boiler is necessary to cook the potatoes fast enough to ensile satisfactorily, but this may not be a serious objection if a large amount of potatoes is available for ensiling.

Slaughter tests were obtained on carcasses from each lot under test. There did not appear to be any significant difference in the score obtained between the lots on the various rations.

Value of Potatoes for Feeding Purposes

The return value of potatoes, when utilized as a supplement to barley in the ration for bacon hogs, is dependent upon the market price of barley. The barley replacement value of one hundred pounds of raw potatoes in these experiments varied from 22·62 pounds when fed as raw potato silage to 32·50 pounds when cooked potato silage was fed.

TABLE 5.—POTATOES AND POTATO SILAGE FOR HOGS

Item	Ration				
	Grain	Grain and cooked potato silage	Grain and raw potato silage	Grain and cooked potatoes	Grain and raw potato silage (cooked)
Average number days on test	101·08	105·75	110·00	98·75	93·13
Average daily gain per hog lb.	1·53	1·49	1·34	1·53	1·66
Grain consumed per 100 pounds gain lb.	323·25	151·47	172·35	150·25	165·32
Potato product consumed per 100 pounds gain lb.	.....	502·48	325·06	571·46	277·18
Barley equivalent of 100 pounds raw potatoes lb.	.....	32·50	22·62	29·64	26·43

Assuming an average return value of thirty pounds of barley per one hundred pounds of raw potatoes, the following returns might be expected with varying barley prices. The cost of cooking or other preparation must be deducted from these values.

Price of Barley per 100 Pounds	Value of Potatoes per 100 Pounds
$	$
1.50	0.45
1.75	0.53
2.00	0.60
2.25	0.67
2.50	0.75
2.75	0.83
3.00	0.90
3.25	0.97
3.50	1.05

Feed Cost of Milk Production

There are many factors that influence the feed cost of milk production. Some of these are the inherent producing ability of the individual cow or herd; kind and quality of feed supplied; the length of the pasture season and the quality of the pasturage. It is only by using long time averages therefore, that any fair estimate can be made of the feed requirements per 100 pounds of milk.

Information has been compiled for a number of years on the monthly feed requirements per 100 pounds of milk produced by the Holsteins at this Station. During the ten-year period 1936-1945 inclusive, an average of 12·9 cows finished a lactation period during each year at the age of four years and nine months. The average production in 365 days was 11,597 pounds of milk testing 3·5 per cent butterfat. The average size of the herd, including cows which were sold before finishing a lactation period, was 18·4 cows. The feed consumption for all the cows including both producing and dry cows, as well as those which were sold before finishing a lactation period was charged against the herd.

The average annual feed consumption per 100 pounds of milk produced in this period was as follows: grain—18·5 pounds; hay—38·4 pounds; succulent feed—(roots, silage and green feed)—70·2 pounds; pasture—1·4 days.

Using the actual cost of production figures for roughage, succulent feed and oats, and charging mill feeds at prevailing local prices, pasture at $2 per cow per month, the average feed cost of producing one hundred pounds of milk and one pound of butterfat was $0·75 and $0·22 respectively.

The value placed on feeds, especially hay, roots and silage, varies widely in different districts, and the feed cost of milk and fat production would vary accordingly. However, the amount of feed required to produce 100 pounds of milk and one pound of fat, as presented above, should be fairly constant for a herd averaging approximately 11,500 pounds of 3·5 per cent milk from all cows completing a lactation period. The application of local prices to the feeds required should give a fair estimate of the feed cost of producing 100 pounds of 3·5 per cent milk in any given area.

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POULTRY

L. Griesbach

Breeding

Poultry breeding and feeding experiments have been carried on with Barred Plymouth Rocks. Investigations regarding the possibility of flock improvement through progeny testing have been carried on under the superior male project. This is a co-operative project between the Central Experimental Farm and several Farms and Stations of the Dominion Experimental Farms Service, in which a progeny test is applied to all pedigreed birds reserved for breeders. The blood of sires with superior progeny is incorporated into the flock from time to time in an attempt to improve the general flock production. The results of the progeny test from 1936 to 1946 inclusive are shown in Table 6.

Besides carrying on breeding work under the superior male project, the pedigreed flock was entered in Record of Performance up until 1947. It was then decided to concentrate on poultry breeding research, and entry in Record of Performance was discontinued. An experiment now under way is designed to study the relative breeding value of full sisters compared according to their pullet year egg production.

Work has also been conducted with fast feathering in Barred Plymouth Rocks. In the spring of 1943, a male carrying the fast feathering factor, which is sex-linked recessive, was received from Ottawa. A fast feathering strain with all the good qualities of the original Barred Plymouth Rocks is being developed.

TABLE 6.—PROGENY TEST

Year	Number of Sires	Number of Dams	Daughters				
			Number Started	Per Cent Mortality	Egg Production	Egg Weight	Body Weight
						gr.	lb.
1936	7	33	171	17·0	191	59	6·0
1937	7	35	167	10·2	185	59	.....
1938	5	28	151	21·3	192	58	.....
1939	6	24	172	11·6	193	60	.....
1940	6	35	258	14·0	212	59	6·5
1941	4	23	175	12·6	205	60	6·9
1942	4	22	259	15·1	219	57	6·4
1943	5	28	219	13·7	211	58	6·7
1944	5	38	242	17·8	218	58	6·6
1945	6	35	234	17·9	210	58	6·4
1946	6	44	214	13·1	219	61	6·6
11-year average	5·5	31	206	15·0	205	59	6·5

Production is calculated from birds alive at the end of the year. Commencing in 1940, birds laying less than one hundred eggs were omitted. This, no doubt, largely accounts for the higher average production shown for each of the last seven years over the previous four years.

Feeds for Fertility and Hatchability

Fertility and hatchability in regular pedigreed matings have improved steadily, until in recent years, the total eggs set have been hatching well over sixty per cent. Some early improvement was effected by providing cool storage for hatching eggs in an unheated cellar and by setting at weekly rather than

ten-day intervals. Breeding has no doubt been responsible for some improvement but possibly the greatest advancement has been made in the field of nutrition.

An experiment in 1937 indicated that a commercial hatching mash may have contained something necessary for hatchability that was not fully taken care of in the home-mixed mash then in use. Previous work had shown that cod liver oil as a source of vitamins A and D was essential in winter rations for good results, so research was confined during the next few years to dried milk, green feeds and other vitamin-rich feeds, particularly those high in riboflavin.

In 1941 an experiment was conducted with five lots of fifty pullets each. The basic ration contained no green feed nor dried milk but was a well balanced laying mash in other respects. One pen was reserved for a check, another had the mash supplemented with two per cent dehydrated cereal grass, and the other three pens had the mash supplemented with 2, 4 and 6 per cent dehydrated alfalfa. The amount of cereal grass and alfalfa was doubled commencing six weeks before the hatching season. The hatching results are shown in Table 7.

TABLE 7.—HATCHING RESULTS—1941

Supplementary Feed	Eggs Set	No. Chicks	Per Cent Fertile	Per Cent Total Eggs hatched	Per Cent Fertile Eggs hatched
Check	1,026	295	86·35	28·75	33·30
4 per cent dehydrated cereal grass	1,036	488	90·15	47·10	52·25
4 per cent dehydrated alfalfa	941	309	90·44	32·84	36·31
8 per cent dehydrated alfalfa	957	451	91·85	47·13	51·31
12 per cent dehydrated alfalfa	1,055	534	93·65	50·62	54·05

The difference of 18·35 per cent in total eggs hatched in favour of the pen receiving cereal grass is highly significant. The mash containing eight per cent alfalfa gave practically the same hatching results as the mash containing four per cent cereal grass. There was some advantage in this test in the use of twelve per cent alfalfa in the mash as compared with eight per cent. From eight to ten per cent is usually recommended, especially when some milk is included in the ration.

An experiment was conducted in 1943 with pure riboflavin, liquid skim-milk and brewers' yeast as sources of riboflavin for breeder mash. The mash for the check pen contained ten per cent dehydrated alfalfa, and the animal protein was supplied by fishmeal and meatmeal. The mash contained 1,555 and the grain 400 micrograms riboflavin per pound. If mash and grain were consumed in equal quantities, the ration would contain 978 micrograms riboflavin per pound. The requirements for hatchability are considered to be 1,250 per pound. The rations for the other pens were fortified with the supplements under test to bring the riboflavin content of the ration up to the accepted requirement. The hatching results are shown in Table 8.

TABLE 8.—HATCHING RESULTS—1943

Supplementary Feed	Eggs Set	Number Chicks	Per Cent Fertile	Per Cent Total Eggs hatched	Per Cent Fertile Eggs hatched
Check	693	341	76·48	49·21	64·34
Dried Yeast	772	468	82·77	60·62	73·24
Riboflavin	618	315	76·54	50·97	66·60
Skim-milk	704	390	73·86	55·40	75·00

The highest percentage of total eggs hatched was obtained from the pen receiving dried brewers' yeast and the highest percentage of fertile eggs hatched from the pen receiving skim-milk. In this test pure riboflavin (or vitamin G) improved hatchability only slightly over that in the check pen. The data would suggest that in the ration used, milk and yeast contained some factor other than riboflavin that improved hatchability. However both milk and yeast are rich in riboflavin and it is now known that a satisfactory level of this vitamin in the ration is necessary for good hatchability. Special hatching rations containing dried milk and dehydrated green grass or other feeds high in riboflavin are recommended. Home-grown feeds such as skim-milk and carefully dried alfalfa may be used, when available, to supplement well balanced laying rations.

Dehydrated Green Feed in Starter Mashes

Experiments were conducted in 1938 and 1939 with brooding and rearing rations supplemented with semi-solid buttermilk, compared with rations supplemented with a mixture of semi-solid buttermilk and dried cereal grassmeal. There was no significant difference in appearance or gains between the chicks on the different rations. Subsequent experiments showed that equally good results could be obtained with dehydrated supplements which were much more easily handled. During the next two years, work on this experiment was confined to a comparison of dehydrated cereal grass and alfalfa as supplements for brooding rations. The starter mash used in 1940 and with minor changes in 1941 consisted of 135 pounds of shorts, 100 pounds each of middlings, cornmeal and ground oat groats, 17 pounds each of fishmeal and meatmeal, 5 pounds each of bonemeal and cod liver oil, 2½ pounds of salt and 1 ounce of manganese sulphate. This mash was supplemented for each of the various pens with two per cent dehydrated cereal grass or two, four or six per cent dehydrated alfalfa. A total of 352 chicks was started on each feed mixture during the two years of the experiment. The average weight of chickens at nine weeks of age is shown in Table 9.

TABLE 9.—AVERAGE WEIGHT OF CHICKS AT NINE WEEKS OF AGE

Supplement	Cockerels		Pullets	
	1940	1941	1940	1941
	lb.	lb.	lb.	lb.
Check—no supplement	1·37	1·50	1·34	1·29
2 per cent dehydrated cereal grass	1·39	1·60	1·38	1·37
2 per cent dehydrated alfalfa	1·39	1·65	1·38	1·39
4 per cent dehydrated alfalfa	1·33	1·54	1·34	1·36
6 per cent dehydrated alfalfa	1·30	1·47	1·35	1·29

In 1940, none of the supplements had any effect on gain in weight up to nine weeks of age. However, in 1941 the chicks receiving either dehydrated cereal grass or alfalfa at the rate of two per cent of the ration, were slightly heavier than those in the check lots. The gains obtained were somewhat lower than may be obtained with some rations but health was good and there was very little difference in mortality between the groups. It is considered advisable to include some high quality dehydrated green feed such as used in this experiment in all starter mashes.

Restricted Versus Full Feeding on Range

Rearing chickens on range where there is an abundance of fresh green feed, has been practised at this Station and the results indicate that this method of rearing is highly desirable. Clover is usually used for poultry range but per-

manent pasture is also satisfactory. Range rearing reduces the total feed consumption and usually produces a healthier, more vigorous bird than rearing in small yards practically bare of vegetation. In recent years, there has been a widely-held belief that restricted feeding of grain and mash on range, rather than self feeding from a hopper, in order to encourage a heavier consumption of grass and clover is both economical and beneficial.

In order to determine the value of restricted feeding on range over self feeding from a hopper, an experiment was conducted in 1945 and again in 1946. The method followed the first year, with only slight changes the second year, was as follows: The chicks were raised during the brooding period in a similar way to the regular pedigreed chicks. The pullets were divided into two lots of 124 each, as evenly as possible, when they were approximately ten weeks old and placed in shelters on range. One lot had access to growing mash and grain in hoppers at all times. The other lot was fed as much dry mash in a trough in the morning as would be cleaned up in one hour. The pullets were not given any other feed until six o'clock, when they were given all the grain they could clean up. The grain was fed occasionally in troughs to determine the amount

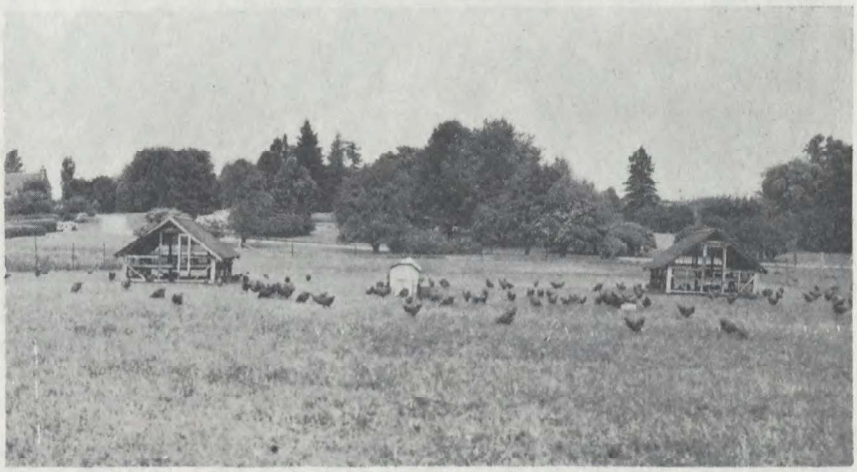

Figure 7—Ample range is required for successful pullet production.

required, but the usual practice was to scatter it on the ground over a large area. Grit and shell were supplied in hoppers. Both lots of pullets had excellent grass and clover range throughout the summer. One hundred pullets from each lot were housed in the fall.

The results indicate that from ten to fifteen per cent in total feed consumption during the growing period can be saved by restricted feeding on range without affecting the birds adversely. There was very little difference in egg production, egg weight, feed consumption and mortality in the laying pens between the pullets which were full fed on range and those which received a restricted ration. However, more skill on the part of the attendant is required to grow good pullets when the amount of feed is restricted than when grain and mash are available at all times in hoppers.

Turkey Raising

Turkey raising in New Brunswick has been given impetus in recent years by the introduction of a new method of rearing. Range rearing often results in heavy losses from blackhead disease because chickens or other fowl, which

are themselves highly resistant to this disease may have contaminated the ground. It is therefore necessary to rear turkeys in complete isolation from chickens. This can be accomplished by rearing the turkeys in pens with floors of wire or slats and never allowing the turkeys to touch the ground.

Turkeys have been reared successfully in wire pens at this Station for four years. A frame measuring 12 by 33 feet was constructed and covered with fox wire. This pen will accommodate one hundred turkeys. The floor joists are

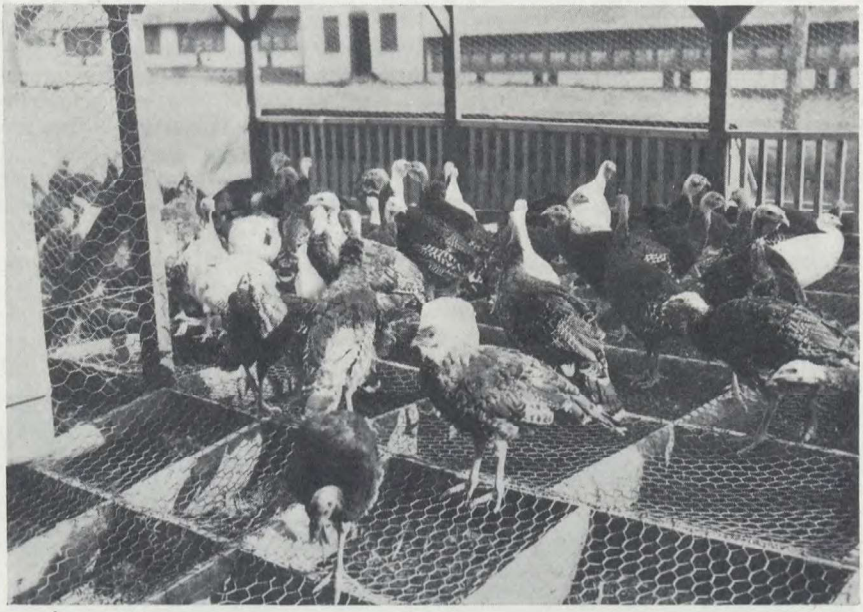

Figure 8—The danger of disease is greatly reduced when turkeys are reared on wire.

eighteen inches apart each way and they are covered with heavy 1½-inch mesh fox wire. Lighter wire can be used for the sides and top. This pen is joined to two brooder houses measuring twelve feet square. When the turkeys are about ten weeks old, they are given access to the wire pen. One side of each brooder house is then opened in order that the turkeys may have ready access to the pens for shelter and roosting. Feed hoppers and water troughs are constructed on the outside of the pen and the turkeys reach the feed between vertical slats.

The first year, half of the turkeys were raised on range fenced off from chickens, and the other half raised in the wire pen. Mortality in the wire pen was 6·90 per cent, whereas on range it was 57·14 per cent, most of which was caused by blackhead. Since then, all the turkeys have been reared in the wire pen. Mortality from blackhead has usually been low but has not been eliminated.

METEOROLOGICAL RECORDS

In general, the climate of the Fredericton district is characterized by a fairly substantial precipitation well distributed throughout the year, and a relatively cool temperature during the summer months. These conditions favour crops grown for livestock feeding such as pasture, hay and roots and of some special crops such as potatoes and most vegetables.

Weather records taken in co-operation with the Meteorological Division of the Department of Transport have been kept since 1914.

The average annual precipitation for the 34-year period 1914-1947 is 39·15 inches. The average precipitation during the summer months is normally ample and is usually distributed almost equally for the three summer months. For example, the average precipitation for the three summer months for the thirty-four year period, has been as follows: June, 3·50 inches; July, 3·20 inches and August, 3·47 inches. Excessive precipitation is not general but during the last 34 years there have been thirteen months with over six inches precipitation, three months with over seven inches and one month with over eight inches.

Average temperatures for the three summer months were as follows: June, 60·66° F.; July, 66·53° F.; August, 64·60° F. These temperatures are somewhat lower than the minimum considered necessary for certain crops. The following quotation from the 1941 U.S.D.A. Year Book, "Climate and Man" will illustrate: "Corn is a warm weather plant that requires a high temperature both day and night during the growing season. Practically no corn is grown where the mean summer temperature is less than 66° F." The low average temperature in June seems to be the most unfavourable condition for corn in this district. Germination is often delayed by cool wet weather in June and growth is slow during the greater part of the month. Only twice in thirty-four years has the mean temperature for June reached 65° F. This rather low

TABLE 10.—METEOROLOGICAL RECORDS

Dominion Experimental Station, Fredericton N.B.
1913-1947 (34 Years)

Month	Temperature F.°			Precipitation			Bright sunshine
	Highest	Lowest	Mean	Rain	Snow	Total precipitation	
				(in.)	(in.)	(in.)	(hrs.)
January	54·0	−38·0	13·38	1·21	21·20	3·33	105·81
February	52·0	−34·0	15·00	·84	18·85	2·72	121·28
March	70·0	−24·0	26·76	1·59	15·28	3·12	144·41
April	82·0	− 4·0	39·66	2·41	8·18	3·23	162·73
May	93·0	23·0	51·22	2·85	·47	2·89	205·08
June	96·0	28·0	60·66	3·50	.....	3·50	204·16
July	97·0	38·0	66·53	3·20	.....	3·20	225·66
August	101·5	37·0	64·60	3·47	.....	3·47	217·02
September	92·0	24·0	56·60	3·59	.....	3·59	159·67
October	84·0	12·0	45·95	3·75	·80	3·83	143·43
November	69·0	− 7·0	33·27	2·53	6·76	3·22	92·62
December	57·0	−28·0	18·74	1·32	17·28	3·05	90·10
Annual	.....	.....	.....	30·26	88·82	39·15	1,871·97

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temperature may explain in part at least, why corn and other crops having similar climatic requirements such as soybeans, have never been grown extensively in New Brunswick. Although good yields of these crops may be secured some years, the average climatic conditions are not conducive to dependable yields.

The length of the frost-free period at this Station is usually ample for the crops generally grown in this district. The average date of the last spring frost for the thirty-four year period is May 19 and the average date of the first fall frost is September 27. This gives an average frost-free period of 130 days. Generally speaking, very little frost damage occurs at this Station. Rather wide deviations from the dates of first and last frost occurrence at this Station sometimes are found at points even fairly close, so these dates may not actually represent a very wide area.

Detailed yearly records on temperatures, precipitation, frost-free periods and dates of farm operations are given in Tables 10 to 13 inclusive.

TABLE 11.—ANNUAL PRECIPITATION

Dominion Experimental Station, Fredericton, N.B.
1914-1947 (34 Years)

INCHES

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1914.....	6·43	1·49	3·23	5·54	1·09	4·34	2·59	3·73	2·78	2·78	2·75	2·03	38·78
1915.....	2·71	2·47	0·70	3·17	4·99	4·98	4·87	4·12	2·75	2·38	2·66	4·49	40·29
1916.....	2·28	3·10	1·88	1·41	2·91	6·12	3·96	1·59	2·95	3·60	2·52	4·10	36·42
1917.....	5·09	2·90	2·27	4·06	3·07	5·10	2·31	6·00	1·05	4·60	1·74	1·93	40·12
1918.....	3·20	3·40	3·60	2·44	2·21	3·06	5·57	1·52	7·62	3·36	3·82	1·19	40·99
1919.....	5·26	1·55	2·25	2·21	3·70	2·24	3·29	2·07	5·21	2·90	2·91	2·34	35·93
1920.....	1·25	6·93	3·58	4·63	0·23	1·67	2·07	3·74	3·43	3·04	1·48	4·08	36·13
1921.....	2·27	1·83	5·17	3·51	1·17	1·05	0·74	3·01	3·08	2·39	4·22	1·20	29·64
1922.....	1·75	2·98	3·31	2·26	2·10	4·61	2·03	5·74	0·52	2·06	2·18	4·17	33·71
1923.....	4·65	0·90	3·93	4·00	1·70	2·53	2·21	2·02	2·05	2·16	3·94	4·22	34·31
1924.....	3·89	1·00	1·63	3·99	2·82	1·69	2·18	4·33	3·69	1·26	2·15	2·27	30·90
1925.....	2·82	2·40	3·90	2·47	1·35	2·41	2·49	2·32	5·17	7·39	4·24	3·23	40·19
1926.....	5·10	4·05	2·17	3·43	2·17	2·06	3·43	6·05	3·01	8·17	3·20	1·85	44·69
1927.....	3·11	4·00	1·76	1·58	3·67	3·73	3·92	5·36	3·19	6·14	3·16	5·33	44·95
1928.....	4·01	1·53	2·98	4·44	2·44	3·77	4·45	6·34	3·02	3·00	2·28	3·52	41·78
1929.....	2·91	2·88	2·80	2·69	5·03	2·52	3·87	2·15	1·91	3·48	2·22	4·18	36·64
1930.....	3·29	2·86	5·10	2·34	2·34	1·79	4·26	3·72	1·97	1·82	1·67	2·75	33·91
1931.....	3·40	1·67	2·52	2·87	2·35	3·88	4·43	2·64	5·67	6·12	1·21	2·69	39·45
1932.....	4·09	1·90	3·52	3·48	3·15	3·82	4·04	3·42	2·20	5·87	1·46	1·89	38·84
1933.....	3·67	2·87	1·97	4·26	2·47	3·88	2·32	5·64	5·86	5·78	3·54	5·10	47·36
1934.....	4·60	3·38	3·25	4·99	1·51	6·39	2·54	2·99	1·58	3·38	4·23	2·45	41·29
1935.....	6·57	2·73	1·88	2·99	1·63	3·95	1·19	2·59	3·89	1·05	6·93	2·35	37·75
1936.....	4·51	2·35	5·71	3·36	3·96	2·02	2·29	3·80	3·44	3·17	3·33	5·73	43·67
1937.....	3·59	2·16	2·86	1·15	3·91	4·36	1·37	3·02	3·53	5·27	3·47	2·83	37·52
1938.....	2·85	3·01	1·81	3·88	4·16	4·04	5·15	3·12	5·03	2·86	4·75	4·58	45·24
1939.....	1·92	3·35	4·41	4·63	2·51	2·24	2·54	0·89	4·15	5·98	0·87	3·39	36·68
1940.....	0·82	2·24	4·19	3·53	3·72	3·95	2·49	3·78	7·91	1·55	6·33	3·26	43·77
1941.....	2·55	0·97	3·81	1·06	2·99	1·66	5·25	5·53	1·86	4·41	3·06	1·92	35·07
1942.....	2·92	2·32	4·93	2·47	1·38	2·80	2·12	1·96	2·86	2·91	2·49	2·02	31·68
1943.....	0·90	3·16	3·00	2·88	3·46	5·03	5·03	5·77	4·32	6·24	3·03	1·07	43·89
1944.....	0·57	3·50	3·35	2·57	2·08	5·23	3·64	1·88	5·87	6·81	5·45	3·86	44·81
1945.....	4·54	2·54	3·33	3·85	8·61	4·89	2·13	0·92	4·20	5·67	3·90	2·64	47·22
1946.....	2·74	4·36	1·57	4·64	3·25	1·42	1·55	2·45	2·82	2·12	3·99	3·32	34·23
1947.....	2·80	3·78	3·68	2·93	3·75	5·71	6·38	3·82	3·58	0·36	3·68	1·66	42·03
34-Year Average	3·33	2·72	3·12	3·23	2·89	3·50	3·20	3·47	3·59	3·83	3·21	3·05	39·15

TABLE 12.—THE OCCURRENCE OF FROST AND FROST-FREE PERIODS

Dominion Experimental Station, Fredericton, N.B.
1914-1947 (34 Years)

(Freezing Temperature 32 degrees F., or lower)

Year	Date of Last Frost in Spring	Date of First Frost in Fall	Days Frost-Free
1914	June 9	September 28	110
1915	June 3	September 26	114
1916	May 22	October 10	140
1917	May 28	September 8	102
1918	May 5	September 11	128
1919	June 1	September 16	106
1920	May 24	September 21	119
1921	May 24	September 21	119
1922	May 17	September 26	131
1923	May 12	October 3	143
1924	May 20	September 26	128
1925	May 24	September 23	121
1926	May 10	September 27	139
1927	June 3	September 28	116
1928	May 14	September 28	136
1929	May 21	September 21	122
1930	May 12	October 4	144
1931	May 18	October 7	141
1932	May 10	September 30	142
1933	May 10	October 12	154
1934	May 20	October 2	134
1935	May 18	October 3	137
1936	May 22	September 30	130
1937	May 19	October 4	137
1938	May 19	October 3	136
1939	May 19	September 25	128
1940	May 12	September 27	137
1941	May 14	September 20	128
1942	May 12	September 29	139
1943	May 16	October 10	146
1944	May 20	September 25	127
1945	May 26	September 18	114
1946	May 11	September 13	123
1947	May 18	September 21	125
Average	May 19	September 27	129·3

Date of latest spring frost on record.....June 9
Date of the earliest fall frost on record.....September 8
Shortest frost-free period on record.....102 (days)
Longest frost-free period on record.....154 (days)

TABLE 13.—DATES OF FARM OPERATIONS

Dominion Experimental Station, Fredericton, N.B.
1921-1947 (27 Years)

—	Earliest	Latest	Average
Spring ploughing	April 14	May 26	May 4
Seeding oats	May 1	June 5	May 18
Planting potatoes	May 10	June 15	May 27
Cutting grass hay	June 22	July 17	July 4
Cutting oats	August 9	August 29	August 21
Date of freeze-up	Nov. 7	Dec. 10	Nov. 24

CEREALS

J. M. F. MacKenzie

The primary objective of the cereal work at the Station is to obtain reliable information on the merits of varieties of wheat, oats, barley, beans, peas and buckwheat so that farmers may know which varieties will give the best results in New Brunswick.

Each year tests are conducted in which the yielding ability and general suitability of promising new varieties and strains of cereals are compared with the best of the established varieties. In these tests, small randomized plots are used and all results are statistically analyzed.

As evidence of the extent of these trials during the twelve-year period 1936-1947 inclusive, some 92 varieties and selections of wheat, 144 varieties

Figure 9—Cereal variety trials have benefited New Brunswick farmers. Early varieties are in demand.

and selections of oats, 42 varieties and selections of hulless oats and 61 varieties of barley have been tested in replicated plots. In addition, a large number of varieties have also been grown in single observation plots.

Those varieties or strains which after careful testing have failed to show definite value over existing varieties are discarded. Their places in the test are taken by promising new material. For this reason, comparatively few of the varieties which were being tested in 1936 were included in the tests for 1947.

Nearly all the new material added to the tests has been developed by the Experimental Farms System. However, promising new varieties from other Canadian sources and to a lesser extent from outside sources, principally the United States, are also included in these tests.

Spring Wheat

During the past eleven years, over sixty varieties and strains of wheat (mostly so-called bread wheats) have been tested for disease resistance and yielding ability. Three of these varieties have been grown for eleven years. Data on these are found in Table 14.

In addition to this test, 28 varieties of soft wheat, suitable for the cake and pastry trade have been tested for yield and general suitability during the last seven years. Cascade has shown the highest yielding ability of any soft wheat tested. It has also shown good resistance to both leaf and stem rust and has been free from mildew. It matures in about 100 days at Fredericton. Descriptive data on the varieties tested will be supplied if required.

TABLE 14.—WHEAT EASTERN RUST GROUP
(11-Year Average 1937-1947 Inclusive)

Variety	Average Yield	Days to Mature	Length of Straw	Strength of Straw*	Weight per Bushel	Weight per 1000 Kernels
	bu.	days	in.	1-10	lb.	gm.
Huron Ott. 3	32·4	99·5	44·7	9·8	61·6	33·3
Coronation II	31·4	98·8	40·6	9·7	61·7	32·5
Regent	30·0	95·2	39·3	9·9	61·8	34·2

* A score of 10 means a very strong straw.

Oats

Oats occupy the third place in value of the field crops in New Brunswick, being surpassed only by hay and potatoes. For this reason, testing of oats is a major project in cereal work at this Station. Victory, a high yielding medium late maturing variety, is used as a check in the standard test. This variety has been grown in test plots at the Station for thirty-four years.

Oat varieties and strains with low yielding ability or with other undesirable characteristics are discarded after careful testing, Therefore, although one hundred and forty-four varieties and strains of common oats and forty-two varieties and strains of hulless oats have been grown in replicated tests in the last twelve years, Victory and Erban are the only oat varieties which have been grown all twelve years. Three varieties of common oats have been grown the last eight years, five the last six, and seven varieties the last four years. The results for eight and four years are given in Table 15.

TABLE 15.—OAT VARIETY TEST

Variety	Yield per Acre	Per cent Hull	Kernels per Acre	Maturity	Length of Straw	Strength of Straw	Weight per Bushel	Weight per 1000 Kernels
	bu.	%	lb.	days	in.	1-10	lb.	gm.
8-yr. av. 1940-47 incl.								
Ajax	80·2	27·8	1,971	88·9	46·8	9·3	34·9	26·2
Victory	76·3	27·2	1,884	98·8	47·7	7·7	37·9	29·8
Erban	73·2	25·6	1,841	93·7	45·6	9·0	33·9	31·7
4-yr. av. 1944-47 incl.								
Exeter	83·2	28·4	2,011	95·0	42·7	9·2	34·6	27·0
Abegweit	79·5	26·8	1,968	94·0	42·9	8·3	34·0	29·2
Ajax	77·8	28·3	1,896	86·1	44·9	9·3	33·6	25·7
Beaver	74·8	25·1	1,881	87·7	44·5	8·9	32·4	30·8
Victory	72·1	27·3	1,770	96·5	45·8	8·0	36·9	28·8
Erban	71·6	25·7	1,787	92·1	43·7	8·9	32·9	30·8
Beacon	67·1	29·0	1,598	89·2	41·1	9·6	36·0	26·5

The following is a brief description of these varieties.

Ajax has been grown in the variety test at the Station during the last eight years. It has given a higher average yield than Victory or Erban for this period. Exeter during the seven years, and Abegweit during the four years they have been grown have each given a higher average yield than Ajax. With these exceptions, Ajax has been the most productive oat grown at the Station. Ajax is about eight days earlier maturing than either Exeter or Abegweit. The first seven years it was grown, it showed good resistance to stem rust. However, in 1947, there were patches with considerable stem rust. This seems to indicate that race 8 of stem rust to which Ajax is susceptible is becoming more prevalent in the Fredericton district. Ajax is not considered resistant to leaf rust but it has never had severe leaf rust at the Station. This oat has strong straw and seems to do well under a wide range of conditions. The grain is small and inclined to be thin, but the per cent hull is not unduly high. It is recommended because it is early, high yielding and adaptable.

Beaver is a Vanguard × Erban cross. It gave a slightly higher average yield than Erban during the six years it has been tested. Both varieties are similar as to size of kernels and strength of straw but Beaver ripens 3 to 4 days earlier. Beaver has shown as much resistance to leaf or crown rust as Erban. In addition, it has shown good but not absolute resistance to stem rust.

Erban, while not so productive as the other varieties mentioned, has shown high resistance to leaf or crown rust during the twelve years it has been tested at this Station. It will produce a fair yield in the years when leaf rust is severe. It is not resistant to stem rust but this disease does not seem to be so general as leaf rust in this province. Erban can be recommended as a medium early variety which does well in many sections of the province. It is four to five days earlier maturing than Victory.

Abegweit has the same parentage as Beaver—(Vanguard × Erban). It has been grown in replicated tests the last four years. It has been more productive than Beaver but it is about six days later maturing. With the single exception of Exeter, it has given the highest average yield for the period it has been grown. It has about the same amount of resistance to stem and crown rust as Beaver. The results at this Station indicate that this variety will be productive when sown early. However, it requires about eight days longer to mature than Ajax.

Exeter has given a higher average yield than any other variety during the eight-year test period. It has good strength of straw and has shown fair resistance to both leaf and stem rust. However, it is rather late maturing. This makes it unsuitable for districts with a short growing season, or when seeding is delayed by unfavourable soil or weather conditions.

Victory is a medium to late maturing variety. Most years the yield is high and the grain plump and attractive. However, it has low resistance to both leaf and stem rust and whenever either of these diseases is severe the yield and quality are greatly lowered. It is not recommended for districts where either rust is likely to be severe and because of its comparatively late maturity, it is not adapted to districts which require an early maturing oat, nor is it suitable when seeding has been greatly delayed by a backward season.

Beacon has been tested for five years. It has shown good resistance to leaf and stem rust. The straw is also relatively strong. However, it is susceptible to root-rot (*Helminthosporium victoriae*) and should not be introduced into this province.

Hulless Oats: A test of hulless oats in replicated plots was carried on for three years, 1941-1943 inclusive and also for the two-year period 1946-1947. Laurel and Brighton gave about the same average yield. Laurel is recommended as the most suitable variety. While it has considerable stem rust some years,

it has exceptionally strong straw and is easily harvested. Brighton has shown good resistance to both leaf and stem rust, but it has weak straw which makes harvesting difficult some years.

BARLEY

Barley is the most suitable home-grown grain for hog feeding. When grown on well drained fertile land, barley has been a fairly safe grain crop in this province. In recent years, it has never been seriously damaged by either leaf or stem rust. Over sixty varieties and strains of barley have been grown in replicated tests during the past twelve years. A number of good yielding varieties have been discarded because they show other undesirable characteristics. Among those remaining in the test for 1947, four were grown all twelve years and six were grown the last seven years. Byng was grown for eleven years, 1936-1946, but was not grown in 1947. In order to include Byng, the yields for 1947 are omitted and the average yields for eleven years, 1936-1946, inclusive and for six years, 1941-1946, are given in Table 16.

TABLE 16—BARLEY VARIETY TEST

Variety	Acre Yield	Days to Mature	Length of Straw	Strength of Straw	Weight per Measured Bushel	Weight per 1000 Kernels
	bu.	days	in.	1-10	lb.	gm.
11-yr. av. 1936-46 incl.						
Byng	54·3	85·8	36·0	8·4	47·3	39·5
Olli	50·2	78·7	34·5	8·4	46·5	35·3
Charlottetown No. 80	47·9	89·5	37·6	8·3	51·5	41·8
Velvet	47·5	85·8	40·7	8·7	47·6	36·4
O.A.C. 21	45·6	84·7	41·3	8·3	46·3	36·4
6-yr. av. 1941-46 incl.						
Byng	54·4	85·9	34·5	8·3	46·8	38·8
Montcalm	50·4	86·8	39·4	7·7	47·6	36·7
Velvet	48·9	85·9	39·9	8·6	47·4	35·9
Galore	48·6	86·0	34·7	8·9	47·0	38·8
Olli	48·4	78·3	34·0	8·0	45·8	34·1
Charlottetown No. 80	47·7	89·2	36·2	8·3	50·8	41·5
O.A.C. 21	44·9	84·7	39·5	8·1	46·0	35·4

Descriptive notes on these varieties are as follows:—

Byng is a six-rowed variety with semi-smooth awns. At this Station it has been a consistently high yielder both in the variety test and when grown in large fields. It has shown low resistance to smut. Under field conditions the straw is rather weak and it is likely to lodge severely, especially if grown on fertile land. Moreover, the heads break off easily and prolonged exposure due to wet weather after cutting sometimes causes the grain to shatter badly.

Olli is a six-rowed variety with rough awns. It has the highest yielding ability of any early-maturing variety ever grown at this Station. The awns are tough and at threshing, unless the barley is very dry, they do not break off close to the grain. The straw is short and if grown on poor land it might be difficult to bind.

Charlottetown No. 80 is a two-rowed variety with rough awns. It is the most widely grown barley in the province. It has not been so productive for the eleven-year period, 1936-1946, inclusive as Byng and Olli and in the six-year period, 1941-1946, Montcalm, Velvet and Galore also have given slightly higher yields. Also, because it is an extra heavy stooler, it is only a fair nurse crop for grass and clover. However, the grain is always excellent quality. It is easily threshed and the awns break off readily. It has not shown outstanding

strength of straw in test plots but it does not lodge readily under field conditions. Because the grain is attractive, has a high weight per bushel, is easily threshed and does well under a wide range of conditions, it can still be recommended as a good barley for the average New Brunswick farmer.

Velvet is a six-rowed variety with very smooth awns. It has been as productive as Charlottetown No. 80 and is somewhat earlier maturing. It has a low weight per bushel and the grain is less attractive than Charlottetown No. 80.

O.A.C. 21 is the most widely grown six-rowed barley in the province and has rough awns. It has not given so good yields as Charlottetown No. 80. It ripens about the same time or a little earlier than Velvet. It has good strength of straw and the heads do not break off so readily as most six-rowed varieties.

Montcalm is a six-rowed variety with smooth awns. During the seven years it has been grown at this Station, it has been a consistently good yielder in the variety test but in 1947 it showed definite weakness of straw and rather low yielding ability when sown about June 10 in a large field. This seems to indicate that this barley is not suitable for late seeding. Also the weak straw of Montcalm under field conditions would cause serious losses some years.

Galore is a six-rowed variety with smooth awns. It has not been so productive nor has it as good appearance in the test plots as Montcalm.

A number of promising unnamed barleys are being tested. One of these has given the highest average yield the last two years.

Field Peas

The field pea acreage in New Brunswick is small, probably because the yield of this crop varies greatly from year to year. Most years the peas escape serious damage from insects and disease but there is an occasional year when aphids, mildew or some other pest lowers both the yield and the quality of the crop. It is often difficult to harvest the crop satisfactorily, since wet weather in the autumn delays ripening, causes shelling and lowers the quality of the peas. Notwithstanding these handicaps, more peas could be profitably grown in New Brunswick. Mixtures of oats and peas or of oats, peas and vetch are grown for supplementary feeding by the dairy farmers in most sections of the province. Because of the high price of seed, peas are always the most expensive item in these seed mixtures. Farmers could profitably grow at least enough to supply their own seed requirement.

During the past twelve years, eight named varieties and seven unnamed strains of peas have been tested. The four named varieties remaining on test in 1947 had been tested all twelve years. However, the yields for 1947 must be discarded as pigeons caused some loss of peas of the latest maturing variety —Canadian Beauty.

The average yield for eleven years, 1936-1946, inclusive is given in Table 17.

A description of the varieties tested will be supplied on request.

TABLE 17.—PEAS VARIETY TEST
(11-Year Average 1936-1946 Inclusive)

Variety	Yield per Acre	Days to Mature	Length of Vines
	bu.	days	in.
Early Blue	43·9	89	36·6
Arthur	38·7	100	56·1
Canadian Beauty	38·2	101	63·2
Chancellor	35·2	95	54·6

Field Beans

Results obtained at the Fredericton Station indicate that New Brunswick is well adapted to the growing of field beans. It is unfortunate that only 900 acres of beans were grown in 1947. The beans grown on this acreage constitute only a small percentage of the amount required to supply the home market. During the last nine years, Lapin has given an average yield of 37·5 bushels per acre which at present prices makes beans a profitable crop.

During the last twelve years, eleven named varieties and thirteen unnamed strains have been tested in replicated plots. Two of the named varieties, Burbank and Navy have been grown for the last twelve years and four of the named varieties have been grown for an eight-year period, 1939-1946 inclusive. The yields of these four varieties are given in Table 18.

TABLE 18.—BEAN VARIETY TEST
(Eight Year Average, 1939-1946 Inclusive)

Variety	Bushels per Acre	Days to Mature
Lapin	39·5	109
Burbank	35·0	109
Gohn's Rainy River	35·0	109
Navy Ottawa 711	35·1	109

Lapin is a white, rather large bean and is extra good quality. It is not resistant to anthracnose, but this disease has never affected the quality of the beans. It is recommended as a consistent high yielding variety when grown on fairly early land.

Burbank is a small white bean. It is good quality but is not considered so good as Lapin. It is susceptible to anthracnose but that disease has rarely been severe enough to affect the quality of the beans.

Gohn's Rainy River is similar to Burbank.

Navy is a medium size white bean. It is fair quality. Most years anthracnose does not affect the quality of the beans but occasionally there are sections of the plots in which the quality and marketability of the beans have been destroyed by anthracnose.

During the last eight years, these four varieties have all matured in an average of 109 days. However, in 1943, Lapin required 121 days and Burbank, Navy and Gohn's Rainy River required 125 days to mature. Therefore, these varieties are rather late maturing for districts with a short growing season, or when seeding is delayed by wet weather in the spring. Under these conditions either Yellow Eye or Soldier are more suitable as they will mature at least five days earlier. Although they have given somewhat lower yields at this Station, they are recommended for districts with a short growing season.

Winter Rye

Variety testing of winter rye was discontinued in 1942. The results for seven years indicated that winter rye would be a rather uncertain crop when grown under conditions similar to those at this Station. During this period, there was no noticeable injury during four winters. Ice caused considerable winter-killing during two winters. The remaining winter, 1935-1936, the rye stands appeared thrifty when the field became bare early in March. Alternate freezing and thawing during late March and April caused the rye to heave out of the ground.

Crown was the highest yielding winter rye tested at the Station. The average yield for six years was 36·5 bushels per acre. This variety was also the most hardy.

Buckwheat

The buckwheat acreage for New Brunswick has decreased rapidly in the last twenty-five years. The Dominion Bureau of Statistics estimated that in 1946 buckwheat was grown on 14,700 acres in the province. This was less than twenty-three per cent of the average acreage as estimated by this bureau for the five-year period, 1916-1920, inclusive.

Part of the decline in buckwheat acreage seems to be due to an improvement in farming methods. Buckwheat, a vigorous forager, is more productive on land in a low state of fertility than any cereal grain. Due to better farming methods and the judicious use of fertilizer, much of this land can now produce fair crops of oats.

A rough buckwheat known locally as Red Straw buckwheat (this buckwheat was named Welsford in 1948) has been the most productive variety in the yield tests at this Station. The smooth buckwheats—Russian, Japanese and Silverhull—have yielded in the order given but there has been very little difference in their yield.

FORAGE CROPS

J. M. F. MacKenzie

The forage plants work at this Station includes experimental work with roots, corn and various annual, biennial and perennial hay and pasture plants and experiments with certain special crops, such as soybeans.

With the exception of preliminary tests for observation, all experimental plots at the Station were arranged in randomized blocks so that the results may be submitted for statistical analysis. Green weights are recorded at time of harvest. The percentage of dry matter at harvest is determined from representative samples. These samples are dried in the electric dehydrator at the Station.

Swede Turnips

Swede turnips are the most important field root grown in New Brunswick. They grow well in all sections of the province, and are the most reliable source of succulent feed for winter feeding of livestock. When grown for table stock, they are considered a profitable cash crop in many sections.

The work with this crop has included variety tests for yield and general suitability; club-root-resistance studies; experiments in the control of brown-heart and seed production studies.

Three varieties—Acadia, Ditmars and Laurentian—have been tested for eleven years. Wilhelmsburger has been grown for six years. Yield records of both green weight and dry matter per acre are given in Table 19.

TABLE 19.—SWEDE TURNIP VARIETY TEST

Variety	Dry Matter	Green Weight per Acre	Dry Weight per Acre
	%	tons	tons
Eleven-Year Average 1936-1945 and 1947			
Acadia	12·82	28·7	3·42
Ditmars	11·29	30·1	3·39
Laurentian	10·60	26·1	2·76
Six-Year Average 1941-1945 and 1947			
Acadia	12·07	27·1	3·28
Ditmars	11·46	28·5	3·27
Wilhelmsburger	11·66	24·8	2·89
Laurentian	10·80	23·4	2·54

A brief description of these four varieties follows:

Acadia is a purple top globe. It is a vigorous grower but inclined to be rough. Only fifty-seven per cent of the roots have been suitable for marketing as table stock.

Ditmars is a bronze to greenish bronze top globe. It is also a vigorous grower and is smoother than Acadia. Sixty-two per cent of the roots have been marketable in size and shape. As a combination variety for table stock purposes as well as for livestock feeding, Ditmars is the most satisfactory variety tested.

Wilhelmsburger is a green top globe. It is rather rough and lacks uniformity. Only fifty per cent of the roots were suitable for table stock. However, this variety has considerable resistance to club-root.

39499—5½

Laurentian is a purple top globe. It has not been so productive as the other three varieties, the eleven-year average yield of roots being 26·1 tons per acre as compared with 28·7 tons for Acadia and 30·1 tons for Ditmars. However, the roots are exceptionally uniform and smooth. Eighty-four per cent of the roots have been excellent table stock. Laurentian is highly recommended for table stock purposes.

Club-Root-Resistant Varieties: The results of co-operative tests with the Laboratory of Plant Pathology conducted in the Lower Saint John River Valley indicate that the club-root organism in that area is particularly virulent. When the disease was severe in this section, none of the varieties or strains listed produced a profitable crop.

Wilhelmsburger is recommended for land slightly infested with club-root. When there is only slight infestation, this variety may either prove resistant or the injury may be slight and confined to the small rootings. When only the small rootlets show the disease, the roots are usually of good quality when trimmed.

Danish Giant, which has more resistance to club-root than any other variety tested, is not recommended because of its poor type and quality.

Swede Varietal Resistance to Brown-Heart: Some varieties have shown considerable resistance to brown-heart but no variety can be recommended as sufficiently resistant to grow where this disease is likely to be severe. Danish Giant, the most resistant variety tested, is of very poor type and quality.

Application of manure has never given satisfactory control of brown-heart at this Station. Nevertheless, swede turnips grown on land which had been given an application of manure have had less brown-heart than if they were grown on land which was given only an application of a commercial fertilizer.

Extensive tests have shown that an application of 10 to 15 pounds of borax per acre in the drills or about 30 pounds of borax broadcast will give excellent control of this disease.

Swede Turnip Seed Production

Laurentian swede turnip stecklings have been grown at this Station each year since 1940. Storage in orange crates has proved somewhat better than storage in bins. This may be due to less rough handling, or to better air circulation in storage or a combination of both.

The stecklings were always planted on fertile land, that is, on land which had been given a broadcast application of sixteen tons manure and 800-1000 pounds of 2-12-6 fertilizer per acre for the previous crop. Even on land in this good state of fertility, seed yields were always increased by direct application of either fertilizer alone or a combination of manure and fertilizer. The fertilizer treatments were 1700 pounds 5-10-5 per acre in 1942 and 1500 pounds 4-12-6 per acre in 1943 and 1944. The manure and fertilizer treatment each year was sixteen tons manure and 500 pounds 2-12-6 fertilizer per acre. Each year, the increase in seed yield made both treatments profitable.

The average yield of seed per acre for the three-year period was—fertilizer alone, 583 pounds, manure and fertilizer, 475 pounds, no manure or fertilizer, 375 pounds.

The results at this Station indicate that when stecklings are grown on land which had been given an application of thirty pounds borax per acre, they do not require additional borax the year they produce seed. For three years—1942, 1943, and 1945 the average seed yield on a relative basis was—no borax, 100 pounds, thirty pounds borax per acre, 98 pounds. There were very few sterile plants following either treatment.

Mangels

The acreage of mangels grown in New Brunswick is small. Therefore, in recent years, the work with mangels has been chiefly confined to the testing of a few leading varieties from Canadian sources. The results show that the yields are usually good when mangels are sown early on deep mellow soils that have been liberally manured and fertilized.

Three varieties—Prince White Sugar, Giant White Sugar and Tip Top—have been tested for eleven years. Frontenac has been grown for seven years. Yield records are presented in Table 20.

TABLE 20.—MANGELS—VARIETY TEST

Variety	Dry Matter	Green Weight per Acre	Dry Weight per Acre
	%	tons	tons
Eleven-Year Average 1937-1947 inclusive			
Prince White Sugar	9·53	28·7	2·76
Giant White Sugar	12·29	22·2	2·72
Tip Top	14·47	17·5	2·53
Seven-Year Average 1941-1947 inclusive			
Prince White Sugar	9·88	28·4	2·85
Frontenac	12·54	21·6	2·73
Giant White Sugar	12·75	21·4	2·73
Tip Top	15·18	16·6	2·51

A brief description of these four varieties follows:

Prince White Sugar is a half long to long type root. It is the most productive variety on the basis of green weight during the eleven years it has been tested. It has a comparatively low percentage of dry matter, only fair keeping qualities and there are some hollow roots each year. It is usually quite easy to harvest.

Giant White Sugar is an intermediate to half long type. It has given considerably lower tonnage of roots per acre than Prince White Sugar but because it has a higher percentage of dry matter, the average yield per acre on a dry-matter basis is approximately the same. It has good keeping qualities.

Frontenac is a yellow intermediate. It is easy to harvest and keeps well in storage. It approximates Giant White Sugar in yield on both a green weight and dry-weight basis.

Tip Top is a short intermediate type with uniform roots. They are easily harvested and have extra good keeping qualities. This variety has the lowest tonnage of root per acre. Although it has a high dry-matter percentage, it has also the lowest yield per acre on a dry-matter basis.

Cercospora, a disease which causes the outer leaves to die, is severe some years. Tip Top has considerable resistance to this disease. Frontenac and Giant White Sugar have slight resistance and Prince White Sugar lacks resistance.

Mangel Seed Production

As there was a surplus of mangel seed in recent years, only a small acreage of mangel stecklings was planted each year. The results indicate that good yields can be obtained in New Brunswick.

Corn for Silage

The acreage of fodder corn grown in New Brunswick is very small. Even in the best corn-growing sections of the province, a relatively small tonnage of corn is put in silos. The bulk of the corn is grown to be used as green fodder to supplement pasture and to a lesser extent as dried fodder.

The test of corn varieties was suspended in 1936 but a test of hybrid corn has been carried on during the last five years. In all tests, the tall, late maturing varieties or hybrids have given the highest tonnage of green fodder but the fodder from this late maturing corn has a lower percentage of dry matter. When the yields of either varieties or hybrids were compared on the basis of dry weight per acre, the yield of late maturing and of medium early corn was about the same. The kernels of the late maturing corn were either watery or barely formed at harvest. The medium early varieties or hybrids had well developed ears and made much superior fodder.

Of the twelve hybrids tested, Canada 255 and Canada 275 are recommended when both yielding ability and quality are taken into consideration. Later sorts such as Canada 606, Canada 645 and Canada 696 will give higher green yields but the dry matter yields are approximately the same and they have poorly filled ears as compared with the earlier varieties.

Corn for Grain

The summer season in New Brunswick is too short to mature seed of the dent varieties. The small, early Flint varieties will mature satisfactorily most years.

Tests of flint varieties for grain were conducted on small randomized plots for four years, 1936-1939 inclusive. The average production for these four years on a relative basis was—Twitchell's Pride, 100; Assiniboine (Squaw), ·81; Manalta, 76; Saskatchewan White Flint, 72; Improved Yellow Flint, 70; Gehu, 65; Howes' Alberta Flint, 63 and Rutherford 59. The average yield of Twitchell's Pride for the four-year period was 72·3 bushels of corn per acre. Unfortunately, the season at Fredericton is too short for Twitchell's Pride to consistently mature seed, thus in 1936, Twitchell's Pride only produced 28·9 bushels of low quality corn per acre. Howes' Alberta Flint was the earliest variety tested but its average yield was only 45·4 bushels per acre. Manalta, Saskatchewan White Flint, Improved Yellow Flint and Gehu are more productive. They are somewhat later maturing than Howes' Alberta Flint but when sown on early land they have always ripened seed satisfactorily at this Station.

Soybeans for Seed

Soybeans have been grown at the Station each year since 1928. In these twenty years, early varieties such as Manitoba Brown and Pagoda have invariably ripened and produced good quality beans. Some years, medium early varieties such as Mandarin have ripened satisfactorily but other years early frost before the beans become nearly mature affected the quality and, to a lesser extent, the yield of beans.

Soybeans are not injured by late spring frost but there is no advantage in sowing extremely early. They germinate slowly and make very slow growth in cool weather. Also, weeds are more likely to be troublesome if the seeding is done before the last week in May.

In the eleven-year period, 1936-1946 inclusive, the average date of seeding was May 29. Manitoba Brown, the earliest soybean variety tested at this Station, has ripened in an average of 115 days or about September 20, which is seven days earlier than the average date of the first frost. Pagoda, the next earliest variety has ripened in an average of 120 days or about September 25. However, the two named varieties with the highest average yield for these

eleven years, Kabott and Mandarin have required an average of 127 and 138 days, respectively, to mature. Soybeans are less susceptible to frost than field beans. Light frosts in the fall, when they are nearly mature, have little effect on the plants. Nevertheless, occasionally the quality of the Kabott beans, and more frequently, both the quality of the beans and the yield of Mandarin have been lowered by frosts occurring before the beans become sufficiently mature.

Therefore, except for a few favoured localities, the relatively short growing season and the cool summer in this province do not favour the profitable production of a seed crop of soybeans. Variety testing is being continued.

During the last twelve years, over one hundred unnamed selections of soybeans from the Division of Forage Plants have been tested at this Station. Two of these selections—Kabott and Pagoda are now named.

The 1947 yields were abnormally high because of location. Therefore, the yields for that year are not included, but the average yields for the eleven-year period, 1936-1946, of the four named varieties grown all these years, are given in Table 21. A description of the varieties tested will be supplied on request.

TABLE 21.—SOYBEANS SEED TEST
Eleven-Year Average 1936-1946 Inclusive

Variety	Yield per Acre	Maturity	Height
	bu.	days	in.
Kabott	26·4	129	30·3
Mandarin	26·3	138	30·7
Pagoda	25·8	120	28·3
Manitoba Brown	24·5	115	22·6

Annual Hays

Ten years' testing of various single species and mixtures for annual hay was completed in 1943. As the results seemed rather conclusive, the testing was discontinued for the present.

The following were tested for yield and general suitability—oats sown at the rate of three bushels per acre; oats and peas at the rate of two bushels of oats and one bushel peas per acre; oats, peas and vetch at the rate of two bushels oats, ¾ bushel peas and ¼ bushel vetch per acre; oats and fall rye at the rate of two bushels oats and one bushel fall rye per acre.

For a five-year period, the average hay yields per acre were—oats 3·04 tons; oats, peas and vetch 3·05 tons; oats and peas 3·01 tons. In this test, oats alone gave approximately the same tonnage of hay as either of these mixtures. However, it is possible that the increase in the nutritive value of the hay when either peas or peas and vetch are grown in a mixture with oats may justify the somewhat higher seed cost.

In three years' testing of oats and fall rye, the average yield was slightly less than 80 per cent of the yield from oats alone. Each year when the oats were in the milk stage, the fall rye was still short bottom grass. This bottom grass made up a very small percentage of the total hay tonnage. Furthermore the fall rye made very little aftermath.

A number of millets have been tested as annual hays. The average hay yield for a five-year period was—Japanese 3·51 tons; Empire 2·99 tons; Siberian 2·19 tons; Red Turghai 2·13 tons; Crown 2·10 tons and Hog 2·04 tons. Japanese, the most productive millet tested, has rather coarse stem and leaves and is late maturing. If the crop is for green feed to supplement pastures, this would not be a serious disadvantage. If millet was grown for hay, Empire which is more leafy and has finer stems and is somewhat earlier maturing

would be more easily cured. Siberian millet is considerably less productive than either Japanese or Empire, but because it is even earlier maturing than Empire, it may be preferable for sections with a short growing season. The broom corn millets—Red Turghai, Crown and Hog have never given as large hay yields as the Japanese and Empire millets.

Three soybeans—Mandarin, Wisconsin Black and Kabott have been tested as annual hays. Mandarin was the most productive. As compared with oats, the average yield of Mandarin for a ten-year period has been—oats 3·05 tons; Mandarin 2·17 tons. Soybean hay has a high percentage of protein and therefore a high feeding value; however the yields are low and it is somewhat difficult to cure.

Sudan grass and Early Amber cane sorghum are not adapted to this district.

During ten years' work, oats proved to be the most reliable and adaptable annual hay tested. Oats cut in the milk stage made excellent hay. Good yields were obtained from early and late seeding on light and on heavy land in dry and wet seasons, and in hot and cool summers. Growing peas in a mixture with oats did not increase the yield but because it increased feeding value the added cost of seed would probably be justified in districts where peas do well. At this Station, when oats, peas and vetch were sown, vetch seemed to make up a very small percentage of the yield. Therefore, it is doubtful whether the addition of vetch is justified since this increases seed cost and adds very little to the feeding value.

At this Station, millet germinates slowly unless seeding is delayed until the ground becomes warm, which is usually after the middle of June. Also cool weather after the millet breaks ground retards growth and allows weeds to become established. Millet sown late in June on warm, fertile, clean land makes rapid growth especially if the weather is hot.

In a favourable season, Japanese millet will produce more tonnage than any other annual hay tested. Also under favourable conditions, Empire Millet will give somewhat higher hay yields than oats. However, oats being a surer crop and much more easily grown than millet, are preferable for the average farm.

Because of low yields, none of the varieties of soybeans tested can be considered a profitable crop to grow for annual hay in New Brunswick. Also, because they grow slowly early in the season, weeds are likely to be troublesome.

Millet Grain Test

Oats and barley both gave larger average yields than the three grain millets—Red Turghai, Crown and Hog, with which they were compared in the five-year period, 1937-1941 inclusive.

Oats produced an average of 2,032 pounds grain per acre; barley 1,978 pounds grain per acre; the grain millets—Red Turghai, Crown and Hog—only produced an average of 1,274, 1,186 and 877 pounds grain per acre, respectively, in the same five-year period.

Timothy Seed Production

Larger yields of timothy seed have been obtained at this Station by ordinary farm practices, than by any other method tested. That is, by sowing a mixture of red clover and timothy when seeding to grain. Except when there was severe winter-killing, the first hay crop was largely red clover. In succeeding years, the crop was largely timothy and this timothy was freer from weeds and produced a larger yield of timothy seed than when timothy alone was sown with the grain.

In 1935, eight pounds red clover and eight pounds timothy were sown on randomized plots with a nurse crop of barley. The first hay crop in 1936 was

nearly all red clover. The next four years, 1937-1940 inclusive, these plots produced an average yield of 288 pounds timothy seed per acre. Adjoining plots given identical treatment except that no red clover was sown, produced an average of only 153 pounds timothy seed per acre for the same period.

When timothy was grown in thirty-inch drills and given row cultivation, the labour costs were much higher and the seed yield was slightly lower than when ordinary farm practice was followed.

When nitrogenous fertilizer was applied for each timothy seed crop, the yield of seed was increased by an average of 85 pounds seed per acre, for the four crop years, 1937-1940, inclusive. The fertilizer application was at the rate of 200 pounds nitrate of soda in the spring of 1937 and 1938. For the 1939 and 1940 timothy seed crop, 200 pounds sulphate of ammonia were applied the previous fall.

Alfalfa

Two year' testing of alfalfa varieties has shown the importance of growing winter-hardy varieties. In has also shown the importance of growing a variety which has ability to recover from winter injury.

The average yields for the last two years, 1946 and 1947, were—Rhizoma 2·94 tons; Ferax 2·68 tons; Grimm 2·56 tons; Ladak 2·32 tons; Cananto 2·27 tons; Ranger 2·15 tons and Buffalo 1·26 tons of hay per acre.

During the winter of 1945-1946, approximately thirty-five per cent of the Buffalo and twenty-one per cent of the Ranger alfalfa sown the previous summer winter-killed. These varieties have given the lowest average yield the last two years. The three varieties with the highest average yield—Rhizoma, Ferax and Grimm—had the least winter-killing, 15, 13 and 10 per cent respectively. Although Rhizoma had slightly more winter-killing than either Ferax or Grimm, the winter-killed sections have filled in so that it has suffered less permanent injury than any other variety.

There was very little leaf-spot on the first crop in 1946 but the second crop had considerable leaf-spot. In 1947, both crops were practically free from this disease. Ladak and Rhizoma were the most resistant.

Rhizoma has given the highest yield but there is no seed of this variety available from commercial sources. When ease of obtaining seed, winter-hardiness and yielding ability are all taken into consideration, Grimm seems to be the most suitable variety at the present time.

Timothy

A test of 24 varieties and strains of timothy indicated that many of them have approximately the same yielding ability. They were all winter-hardy. This was shown by their survival during the winter of 1945-1946, when nearly all the red clover at the Station winter-killed.

A selection from the Division of Forage Plants, Ottawa, gave the highest average yield for the last two years (1946 and 1947)—2·68 tons per acre. The next highest yielding varieties were Lorain, 2·63 tons; Nappan, 2·61 tons; Composite U.S.D.A., 2·60 tons; and Milton, 2·60 tons per acre. The difference in the yield of these timothies was not significant.

Seed Mixtures for Pastures

Special seed mixtures for seeding down pastures are often recommended in different parts of the country. These mixtures vary from some fairly simple mixtures, containing only a few species, to quite complex mixtures containing a dozen or more species. Undoubtedly these recommended mixtures have proved valuable under certain climatic and soil conditions. Notwithstanding the results obtained elsewhere, unless something is known of the adaptation of the recom-

mended species to local climatic and soil conditions these complex mixtures may mean higher costs without achieving any better results than can be secured with a very simple mixture.

In order to obtain reliable information in this respect, a test consisting of five mixtures of grasses and clovers and five single species was carried on at this Station from 1932 to 1940. Two plots were left unseeded and each of the mixtures or species was grown in duplicate plots. All plots were fertilized with 100 pounds nitrate of soda, 280 pounds superphosphate (20 per cent) and 100 pounds muriate of potash per acre each year during the first four years and half that amount yearly thereafter for the duration of the experiment. These plots were seeded down with a nurse crop of Victory oats in 1932 and grazed each year from 1933 onwards.

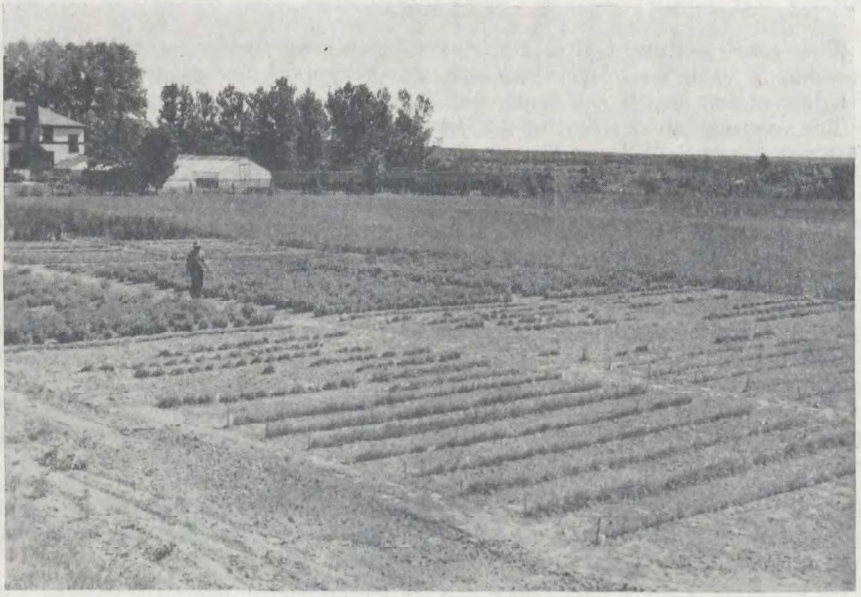


Figure 10—Forage crop nursery. Note variation in winter-killing.

The results during the eight years this experiment was in progress showed that, under conditions similar to those at this Station, complex seed mixtures are not necessary for seeding down pastures. Yields of herbage during that period were higher on plots that were sown with single species and even on the plots left unseeded than on those sown with various complex mixtures. Even plots sown with crested wheat grass, which winter-killed one hundred per cent the first winter after seeding, produced more herbage than those sown with complex mixtures.

This is evidently due to the fact that volunteer wild white clover and desirable grasses will establish themselves very quickly under the pasture conditions of this Station. For instance, the plots left unseeded were approximately 85 per cent covered with grasses and wild white clover by the beginning of the second grazing season.

Many of the species used in this test were not adapted to grazing nor sufficiently winter-hardy to persist under grazing conditions. For instance, crested wheat grass, tall oat grass and alfalfa completely winter-killed the first winter.

The elimination of species not adapted to grazing nor to the climatic conditions was so complete that by the beginning of the fifth grazing season the turf on all plots was practically identical and was composed largely of Kentucky blue grass and wild white clover with a small percentage of other grasses such as timothy and brown top.

As a result of these findings and observations from other experiments the seed mixture recommended for seeding pastures consists of a simple hay mixture, namely ten pounds of timothy, six pounds of red clover (Canadian grown) and four pounds of alsike clover per acre.

This mixture will produce excellent hay or pasture for a year or two and while these species will not persist under grazing, they will be replaced by volunteer clover and grasses which will produce excellent pasture, provided fairly liberal fertilization and good pasture management are practised. This mixture also has the advantage of being cheap and easily obtainable. The money saved by not buying an expensive seed mixture can more profitably be used to purchase pasture fertilizer.

It may well be that in some areas wild white clover will not volunteer so readily as it does at this Station. Where this is known to be the case it would be necessary to add one pound of white clover seed per acre to the above mixture for seeding down pastures.

39499—6½

FIELD HUSBANDRY

T. C. Chiasson, J. M. F. Mackenzie and Leonard Griesbach

Barnyard Manure and Commercial Fertilizer

Tests carried out at the Fredericton Experimental Station have shown quite strikingly the value of farm manure in maintaining yields of all crops in the rotation, especially clover and timothy.

A test comparing farm manure and commercial fertilizers for hay and grain in a four-year rotation which has been in progress at the Fredericton Station for twenty-four years, will help to illustrate. The treatments and results are shown in Table 22.

It is quite evident that both manure and commercial fertilizer treatments increased yields and gave greater profits per acre than the rotation without manure or fertilizer.

While manure gave slightly better yields, the cost per acre when manure is valued at $1.50 per ton is higher than for the fertilizer treatments based on current market prices. As a result, the returns per acre have been slightly lower from the manure than from the fertilizer treatments. Yields have been rather low in this experiment, possibly due to lack of calcium and these plots are now receiving three tons of ground limestone per acre on the ploughed ground in an attempt to increase yields.

Results from this and other tests indicate that to maintain maximum yields of all crops in the rotation, the following points should be kept in mind.

1. Liming will be necessary from time to time. Soil tests are useful in determining lime requirements.

2. Commercial fertilizers should be used to supplement the manure available on the farm and in this manner will return good profits. However, manure should not be neglected but should be used to the fullest extent possible.

An attempt should be made to apply at least eight tons of manure per acre sometime during the rotation and probably it would be best applied on the oat stubble for the clover crop. Applying manure at this stage has several advantages as compared with applying manure for the hoed crop or the grain crop. For instance, it is very beneficial to the clover crop as it will help to develop a strong plant and will protect it to some extent from winter injury. It will reduce the amount of weeds in the hoed crop and will minimize the danger of lodging in the grain following the hoed crop. In addition, it will be spread at a time of the year when labour can be more easily spared for this operation.

TABLE 22.—MANURE VERSUS COMMERCIAL FERTILIZER FOR HAY AND OATS
Twenty-Four Year Average 1924-1947 Inclusive

Treatment per Acre	Yield per Acre		Return per Acre Over the Cost of Treatment*	
	Oats	Hay	Oats	Hay
	bu.	tons	$	$
A. Eight tons manure per acre on the oat stubble and eight tons before the last hay crop	48·39	1·76	23·81	13·05
B. One hundred pounds nitrate of soda, one hundred pounds superphosphate (20%) and twenty-five pounds muriate of potash per acre to the hay crops	46·76	1·66	26·45	14·90
C. No manure or fertilizer	36·35	0·83	21·14	8·84

* Values and costs on 1947 basis.

A commercial fertilizer such as 400 pounds 4-12-6 per acre for the oat crop and nitrogen fertilizer such as 75 pounds ammonium nitrate for the second and third hay crop should prove beneficial.

Limestone

The value of lime in increasing yields of clover hay in the common grain and hay rotations has been well proven by many experiments. However, when the rotation includes a crop of potatoes, the problem of how to raise a good crop of clover becomes more difficult. The use of lime in amounts which give maximum returns with clover brings about a soil condition which favours the development of the potato scab organism and applications of lime at these rates are unsafe in a potato rotation. Nevertheless, there are cases where heavy applications of commercial fertilizer in a short rotation and continued removal of crops over a relatively long period without replenishing the lime content of the soil has left the land so strongly acid that it is now impossible to secure a good catch of clover.

A good example of this kind was developed on a potato rotation at the Fredericton Experimental Station. A three-year rotation of potatoes, grain and clover hay has been under way since 1931. The only fertilizer treatment on this rotation was 2,000 pounds 4-8-10 for each potato crop.

By 1940, yields of grain and hay had become so small that it was evident that something must be done to increase yields. Potato yields were also declining rapidly. Consequently, the whole area was divided into small plots and given treatments of limestone and manure. These have resulted in greatly increased returns. When both were applied, clover yields have been more than doubled. These treatments and the five-year average yields of clover are shown in Table 23. It should be noted that the whole area including the check plot

TABLE 23.—EFFECT OF MANURE AND DOLOMITIC LIMESTONE TREATMENTS ON YIELDS OF CLOVER IN A ROTATION OF POTATOES, OATS AND HAY

Treatment per Acre	Average 5 Years Clover Hay
	tons*
Check—no additional treatments	0·29
8 tons manure on oat stubble	0·47
8 tons manure on oat stubble, plus 500 pounds dolomitic limestone	0·84
500 pounds dolomitic limestone	0·52

* Yields from one cutting only.

still received 2,000 pounds 4-8-10 per acre for the potato crop. If red clover had survived each winter during this period, it would be expected that the effect of lime would be still more striking. For instance, in 1947 red clover came through the winter with very little injury at this Station. The photographs in Figure 13 indicate clearly the effect of lime and manure on the stand and yields of clover hay. Note the almost complete absence of clover on the check plot, the good growth but rather thin stand on the manure plot, and the thick stand on the plot with manure and lime (height of post in photographs is identical in each case). These treatments have not caused any scab on the potatoes to date.

It is recognized that the problem of lime used in conjunction with potato production requires further study. All the dolomitic limestone used in these experiments was finely ground, a fact which is quite important in relation to scab occurrence. The possibility of using larger amounts than indicated here should undoubtedly be investigated. Nevertheless, the above results indicate

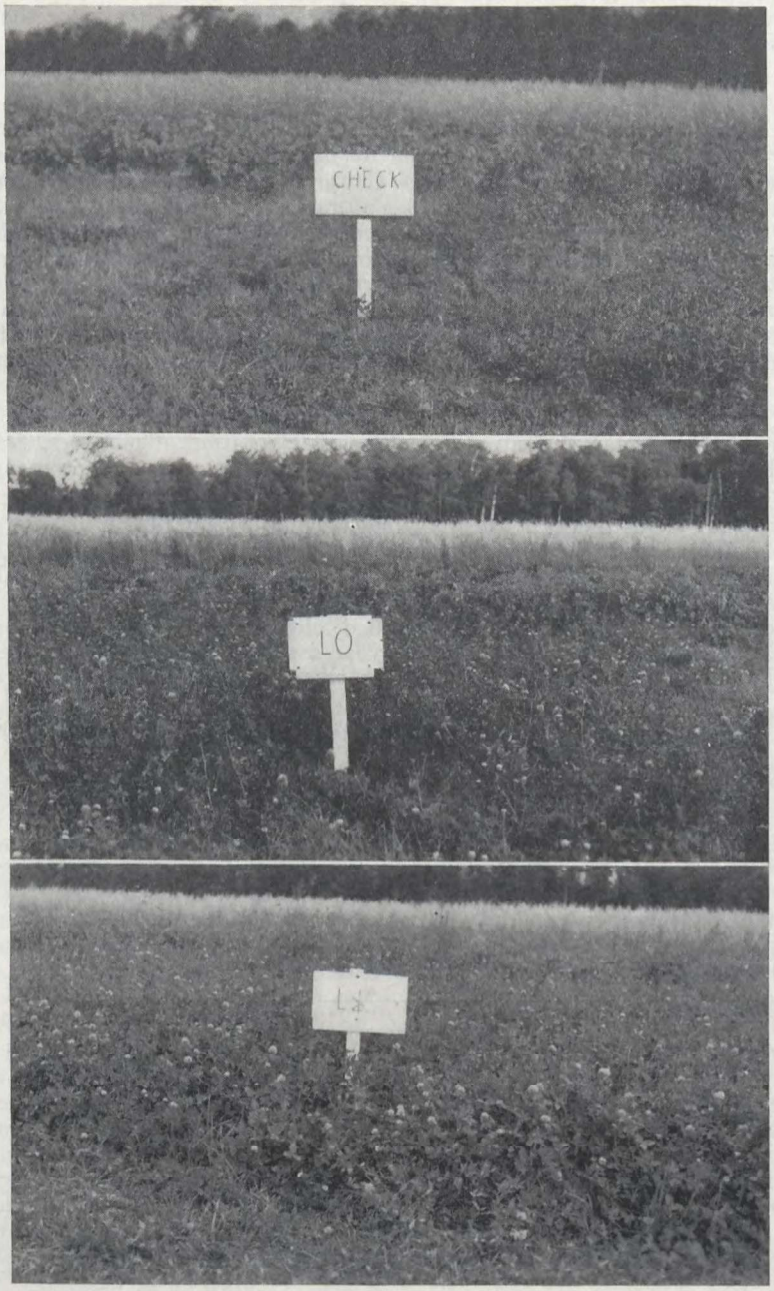


Figure 11—Effect of manure and dolomitic limestone on yields of clover in a potato rotation at Fredericton (1947). (Top) No lime or manure—0·43 tons. (Middle) 8 tons of manure per acre—0·63 tons. (Bottom) 8 tons of manure plus 500 lb. dolomitic limestone—1·52 tons.

that a more widespread use of limestone even in small amounts would be beneficial in obtaining better clover sods, thereby improving the organic-matter content and physical condition of the soil.

Fertilizer Placement for Potatoes

An experiment designed to test the value of applying commercial fertilizer on the plough sole for potatoes and the effect of this practice on the succeeding crops of grain and hay has been under way since 1944. During this period the yields of potatoes have been rather variable and while there has been a slight increase in yields of potatoes from applying fertilizers at plough depth, it is doubtful whether this increase would pay for the extra expense in following this practice.

Yields of oats and hay following the potatoes have not shown any difference between treatments.

Pasture Improvement

Pasture improvement studies were begun at this Station in 1923. Previous to that time, pastures at this Station had never been fertilized and the production of nutrients per acre, compared with present day standards was low and of inferior quality. In order to maintain satisfactory production, milch cows had to be fed a grain ration throughout the summer as well as other supplementary feeds such as green oats or silage during the dry weather of July and August.

The use of fertilized pasture has permitted earlier grazing in the spring, reduced the amount of grain required and eliminated for the most part, the necessity of providing supplemental green feed in the barn during the summer. The satisfactory performance and thrifty appearance of the animals are evidence of good nutrition, credit for which should go partly, no doubt, to fertilized pastures. The incidence of disease, particularly milk fever has considerably lessened since a planned program of pasture fertilization was put into effect at this Station.

Pasture Management

Results of experimental work with dairy cattle at this Station have emphasized the importance of good pasture management. They have shown that fertilized permanent pastures well managed, provide the most suitable and economical summer feed for dairy cows.

In order to produce a large amount of nutritious feed, pastures must be grazed heavily early in the season to prevent the grasses from heading out, thus reducing the competition of grasses with wild white clover. As the season advances, sufficient growth should be left to protect the land from excessive drying out. It is also considered advisable to avoid grazing the herbage very short late in the fall. If this precaution is taken, there will be less winter-killing and growth should be earlier and more vigorous in the spring.

At the Fredericton Station, an attempt is made to utilize fertilized pastures, unimproved pastures and supplementary pastures in the most efficient way possible.

Grazing is started as soon as possible on the fertilized pastures with approximately two cows per acre. By the time the herbage becomes short on the fertilized pastures, the cows are shifted to unimproved pastures in order to take advantage of the June flush. The fertilized pastures are thus rested until revived sufficiently to be grazed again. This grazing and resting at intervals, which is a modified form of rotational grazing, is carried on throughout the summer.

Some kind of supplementary pasture will be necessary. At this Station, this is generally furnished satisfactorily by aftermath from early cut hay and aftermath from fields in the regular rotation, especially from the first-year clover. It is interesting to note that fields at this Station which were seeded in 1929 and maintained in a good state of fertility, have been yielding up to a ton of hay per acre and providing good grazing when the regular pasture is short. This hay is cut early, just as the grasses are heading out. Early cutting is essential in order to promote growth for use later in the summer when the regular pastures are normally short. In effect, this means increasing the acreage of fertilized pasture, dividing it in two or more sections and utilizing any excess growth on one of them for hay.

In other sections of the province and in dry years, the above sources of supplementary pastures may not be sufficient. Under these conditions, the best solution appears to be the use of annuals for supplementary pastures or green feed. An area of oats sown rather late would help furnish a sufficient amount of supplementary pasture. The oats can be pastured if necessary and, if not, can be harvested for oat hay or could even be ripened in a favourable season. The oats should be pastured when from eight to ten inches high and only for a short period each day so as to avoid excessive tramping and spoilage. If pasturing is begun too late, for instance after heading has started, it will not grow up again.

It has been found necessary to mow pastures at this Station about the middle of June or soon after. This helps to control weeds, removes grasses which have already headed out and gives wild white clover an opportunity to become better established. It also helps to promote the growth of palatable nutritious herbage.

The use of a chain harrow on pastures in the fall is also advisable. Harrowing spreads droppings and helps to prevent rank growth around them the next summer. It also loosens the turf and permits the growth of new clover and grasses.

Commercial Fertilizer for Permanent Pastures

Grazing Experiments

The pasture fields on which grazing records are kept have been used since 1936 for an experiment on rate of fertilizer application. Records are kept of maintenance requirements, gain or loss in weight, milk production and supplementary grain or other feed consumed. The production of total digestible nutrients by each pasture is calculated. One animal unit equals sixteen total digestible nutrients which is the requirement for maintenance and production of a 1,000-pound cow producing twenty-five pounds of four per cent milk daily. Yield of herbage is also determined from four wire cages on each field. The herbage under each cage is cut four times each season. This herbage is dried until all moisture is removed and yields are expressed in pounds of dry matter per acre. After each cutting, the cages are moved to a new location which was closely grazed. The results are shown in Table 24.

Both the grazing results and the yield of dry matter were highest from the field receiving nitrogen, phosphorus and potash. The cost of the increased yield was highest from this field but still low enough to be profitable. The field receiving small annual applications of superphosphate and potash gave a higher yield of dry matter but fewer animal units than the field receiving an equivalent amount of these minerals once every four years. It would appear that yields might be expected to be the same whether the minerals are applied in small annual applications or equivalent amounts at four-year intervals. Superphosphate alone gave the lowest increase in yield of the fertilized fields but at

a lower cost. The check field yielded only about one-half the dry matter and animal units produced on the fertilized fields. The quality of the herbage on the unfertilized field was also inferior consisting mainly of brown-top and weeds.

The results at this Station were obtained on pastures which were already in a high state of fertility which accounts for the high carrying capacity at relatively low cost. In general practice, it is usually necessary to fertilize somewhat more heavily the first few years until a good sod is established, than is necessary in later years. The application of 560 pounds superphosphate and

TABLE 24.—EFFECT OF COMMERCIAL FERTILIZER ON PERMANENT PASTURES
Eight-Year Average

Item	Fertilizer Treatment				
	140 P. and 50 K. annually	100 N. Annually 560 P. and 200 K. every 4 years	560 P. every 4 years	560 P. and 200 K. every 4 years	Check
Animal units	178	201	159*	185	94
Dry matter lb.	6,057	6,584	5,311*	5,655	2,640
Increased yield over check lb.	3,417	3,944	2,970*	3,015	.....
Cost of fertilizer per year $	2·62	4·35	1·61	2·32	.....
Cost per ton of increased yield over check $	1·53	2·21	1·09	1·54	.....

* Four-year average
P—Superphosphate
K—Muriate of Potash
N—Nitrate of Soda

200 pounds muriate of potash per acre every four years, or one-quarter this amount applied annually, can be recommended when a good sod has been established. Heavier applications can be made occasionally if considered necessary, and a nitrogenous fertilizer should be added until a satisfactory stand of wild white clover is obtained or if heavy growth is desired early in the season.

DATES OF APPLYING FERTILIZERS TO PASTURES

In the past, pasture fertilizers have usually been applied in the spring of the year. Several difficulties are connected with this practice. The sod on pastures is frequently too soft for the fertilizer to be applied before the rush of the spring work begins. As a result, the application of pasture fertilizer is often delayed until too late for the grasses and clovers to make the most effective use of it that year. Should an attempt be made to apply the fertilizer while the ground is soft, severe cutting of the sod by the horses and the machinery may result. If pasture fertilizers could be applied in the fall of the year with results comparable with spring applications, most of these obvious difficulties would be eliminated.

In order to determine the value of fall applications of pasture fertilizers, two experiments have been carried on at this Station during the past ten years.

The first experiment, designed to test the effectiveness of fall applications of nitrogenous fertilizers, was begun in 1938. These plots were laid down on an area of fertilized pastures which had previously received 100 pounds nitrate of soda each year, plus 560 pounds superphosphate and 200 pounds muriate of potash per acre every four years.

During the period of this experiment, the minerals were applied in the spring at the usual rates but the nitrogen was applied on three different dates, viz., September 15, October 15 and in the early spring.

The five-year average yield of this experiment was slightly in favour of applying nitrogenous fertilizer in the spring but this increase was only 114 pounds

of dry matter over the early fall application, made about September 15. These results were not consistent since during the first two years of this experiment, early fall applications were definitely superior to other dates.

It seems possible that weather may play a major role in the response of pastures to the application of nitrogenous fertilizers at different dates. Early fall application, however, seem definitely superior to late fall application so far as nitrogenous fertilizer is concerned, and is recommended in view of the advantages of applying in the fall as compared with early spring.

In order to secure additional information on the relative value of fertilizers applied on pastures at different dates, a more comprehensive experiment was begun in the fall of 1943. The plots were laid down on an area that had been in a hay and grain rotation for 14 years and had been seeded down with an ordinary hay mixture in the spring of 1942. This area has been grazed each year since 1943 but the sod is still patchy in places. Treatments and average yields are shown in Table 25.

TABLE 25.—RESULT OF APPLYING COMMERCIAL FERTILIZERS TO PASTURES AT VARIOUS DATES

Four-Year Average

Treatment	Dry Matter per Acre		
	Applied Sept. 10	Applied Oct. 10	Applied in the Spring
	lb.	lb.	lb.
500 pounds 0-12-10 per acre	3,911	4,439	4,143
500 pounds 4-12-10 per acre	4,527	4,978	4,698
500 pounds 0-12-10 (about Sept. 10) plus 100 pounds nitrate of soda on dates indicated.	4,966	4,893	5,402
Check—No Fertilizer	3,112	.....	.....

The results from these two experiments comparing the date of applying pasture fertilizer would indicate that practically as good results might be expected from fall as from spring applications. The slight advantage in growth which might result from spring application is more than offset by the delay that often occurs because of the cutting of the sod resulting from applying fertilizer in the spring when the ground is soft.

PASTURE EXPERIMENTS WITH SMALL PLOTS

A considerable number of fertilizer formulae have been tested on small plots at the Fredericton Station during the last twelve years. While results from small plots are not always as clear cut as would seem desirable, they nevertheless indicate certain trends which are obviously important. For instance, an experiment designed to show what rate of potash in combination with other elements would give best returns per acre on permanent pastures, was carried on for eight years. From this experiment the following conclusions, substantiated by trials on larger fields, were drawn:—

First, in combination with phosphorus and nitrogen, potash decidedly increased yields of herbage, the heavier applications giving the greater increases. However, a point is quickly reached where any additional increases in the rate of potash increases the cost beyond what may be considered profitable.

Secondly, potash alone is not an effective pasture fertilizer, although it will increase yields to some extent.

Thirdly, both muriate of potash and superphosphate are necessary to maintain satisfactory yields. Neither muriate of potash nor superphosphate alone nor either one in combination with nitrate of soda was profitable. The lack of phosphorus became noticeable much more quickly than the lack of potash.

Results indicate that a complete fertilizer such as 2-12-6 or 2-16-6 will generally give good results. On a pasture in a low state of fertility, where no wild white clover is present, a 4-12-6 formula would likely give better results.

Proper Moisture Content of Clover Essential to Good Silage

Clover silage has been made and fed at the Experimental Station since 1939. It has largely replaced roots as a succulent feed for dairy cattle and is generally highly regarded by dairymen, especially those selling whole milk.

It has been demonstrated that good quality clover silage can be made without the use of molasses or other preservative, if the moisture content of the forage is between sixty and seventy percent. However, clover in this district normally contains about eighty per cent moisture when in full bloom and should be wilted before ensiling, in order to reduce the moisture content to about sixty-five per cent or poor quality silage will result. Wilted clover must be packed thoroughly as it is ensiled and the silage should be topped off with heavy green material. In practice, it is usually considered advisable to add about sixty pounds of molasses per ton of clover.

Various methods of handling clover for ensilage were investigated at this Station. Cutting with a mower, preferably with a windrower attached and loading with a strongly constructed hay loader proved satisfactory. The clover is ensiled with an ordinary ensilage cutter and blower. A machine, the forage harvester, which mows and chops the clover and elevates it into a trailer, has been used at this Station for several seasons. This machine increases the machinery cost but cuts the amount of labour required by about one-half. The big disadvantage in the use of this machine lies in the fact that wilting of the crop is not possible before ensiling. A harvester with a pick-up attachment overcomes this difficulty but the cost of harvesting is increased.

The loss of dry matter incurred by ensiling at Fredericton has been calculated since 1943.

The results show an average loss of 12·81 per cent from shrinkage and spoilage.

The loss due to spoilage has been kept to a minimum by carefully sealing the top of the silage. This is accomplished by tramping and levelling the silage at intervals of three or four days after filling is completed, until all settling has ceased.

Weed Control

Experiments were conducted by this Station in 1946 and 1947 with various formulations of 2,4-D for weed control on lawns, pastures and cereal grains. These experiments included a study of the effectiveness of the various types of 2,4-D formulations available in killing weeds and their effect on the crop. Rates and time of application for various weeds and crops were also studied. The main conclusions from these experiments are summarized below:

LAWN WEEDS

Perennial weeds in lawns such as dandelion, plantain and fall dandelion can be effectively controlled by one application of 2,4-D at rates recommended by the manufacturers without injury to the grasses.

The best time of application to kill perennial weeds on lawns is when the weeds are growing actively and before they reach the flowering stage. At this Station, this is generally during the first part of June.

Very little difference has been found between the various formulations of 2,4-D offered for sale and the active ingredient is the amount of free 2,4-D acid in the product.

Some perennials such as perennial sow thistle and Canada thistle can be killed with 2,4-D but stronger solutions are required and a second application soon after regrowth has started is necessary. It should also be remembered that even if all the weeds in a lawn can be killed by one application of 2,4-D weed seeds that germinate afterwards will be healthy and unaffected by the previous spraying, so additional spraying from time to time will be necessary to keep lawns free of weeds.

WEEDS IN CEREAL GRAINS

2,4-D appears to be a cheap and effective control for many annual weeds in grain crops. Wild mustard, lamb's quarters and lady's thumb can be satisfactorily controlled with amounts as low as ¼ pound of free 2,4-D acid per acre without injuring the grain crop.

Rates of application in excess of a ½ pound of free 2,4-D acid per acre have caused injury to the grain crop and reduced yields in most cases.

Best results are obtained if the spray is applied when the weeds are actively growing and before they reach the flowering stage. In grain crops, spraying should be done when the grain is from six to ten inches in height. Grain should not be sprayed after it reaches the shot blade stage.

Rather serious injury to red and alsike clover has been noted at this Station whenever grain seeded down has been treated with 2,4-D. For this reason, spraying of grain seeded down to clover is not recommended. However, some reports indicate that when a very thick stand of wild mustard is present, grain may be sprayed without harming the clover, due to the protection afforded by the mustard foliage.

Some annual and perennial weeds in grain cannot be controlled with 2,4-D. The chief ones noted at this Station are couch grass, barnyard grass and spurrey.

PASTURE WEEDS

Many perennial weeds in pastures can be killed with one application of 2,4-D. Among these are plantain, fall dandelions, dandelions and burdocks. Other weeds such as buttercup are partially killed by one application of one pound free 2,4-D acid per acre. Results at this Station indicate that from fifty to seventy per cent of the buttercups can be killed by one application at this rate. Spraying every year in early June should easily bring them under control.

Many crops are susceptible to injury and, therefore, cannot be sprayed with 2,4-D to control weeds. Among these crops are turnips, practically all vegetables, flowers and some trees. A sprayer used for spraying 2,4-D should be thoroughly cleaned by rinsing with water several times before using it to spray susceptible crops.

Cost of Producing Various Crops

Records of the various items pertaining to the cost of producing a number of crops have been kept at the Fredericton Station for a long period of years. However, when an attempt is made to express these factors on a monetary basis which will be of value to farmers, in general, many difficulties are encountered. Practically all the cost factors that enter into crop production are extremely variable from district to district and from year to year. For instance, an hourly wage which is satisfactory to one farmer, may be entirely unsatisfactory to a farmer in another district. Actual cost of fertilizer, seed and labour will also vary considerably. It would thus seem impossible to compute a simple table showing costs on a monetary basis that will apply to all sections of the province. However, the actual hours required in preparing land and harvesting crops will be approximately the same on all efficiently managed farms. In order that farmers may make use of the information available at this Station, the various factors involved in producing crops are presented in Table 26.

This table shows the average yields and various cost of production factors for oats, hay, corn for ensilage, and swedes. These crops were grown in a six-year rotation, consisting of hoed crop, oats, hay, hay, hay and oats. The data shown for oats are an average for oats following hay, and oats following hoed crops. The data shown for hay are an average for the three hay crops in the rotation.

No attempt has been made to give a monetary value to all the factors involved, but instead the amounts of manure, fertilizer and seed and the hours of labour as recorded for growing these crops are shown. In this way, it is

TABLE 26.—YIELDS AND COST OF PRODUCTION FACTORS FOR ONE ACRE OF VARIOUS CROPS

Items	Oats	Hay	Corn for ensilage	Swedes
Number of years grown....years	10	10	5	10
Rent and taxes....$	5.00	5.00	5.00	5.00
Manure[1]....tons	.....	5.3	8	8
Lime[2]....tons	1/6	1/6	1/6	1/6
Fertilizer[3]....lb.	400	.....	1000	1000
Seed....bu.	3.5	1/3 of seed mixture	35 lb.	3 lb.
Machinery....$	2.85	2.85	2.85	2.85
Ensilage cutter....$	.....	.....	3.00	.....
Twine....lb.	3.1	.....	.....	.....
Manual labour....hr.	20.0	16.1	92.7	185.8
Horse labour....hr.	18.5	9.4	59.4	67.3
Tractor labour....hr.	3.9	0.1	3.1	3.8
Average yield per acre....	Grain 50.9 bu. / Straw 1.03 tons	2.31 tons	13.51 tons	23.53 tons
Per cent dry matter....%	Grain 90.8 / Straw 88.5	77	17.10	11.35
Total dry matter per acre....tons	1.70	1.78	2.31	2.67
Per cent T.D.N.[4] ....%	Grain 70.4 / Straw 45.6	42.9	11.48	9.8
Total T.D.N....tons	1.09	0.99	1.55	2.31
Number of hours required to produce 1 ton T.D.N. — manual labour	18.3 hrs.	16.3	59.81	80.4
Number of hours required to produce 1 ton T.D.N. — horse labour	17.0 hrs.	9.5	38.32	29.13
Number of hours required to produce 1 ton T.D.N. — tractor labour	3.6 hrs.	0.1	2.00	1.6

[1] 24 tons of manure per acre each cycle of rotation.
[2] 1 ton lime per acre when seeding down.
[3] For oats and corn, formula used was 4-12-6. For swedes, 2-12-6.
[4] Total digestible nutrients.

hoped that any farmer will be able, by applying his own values for these various items, to calculate fairly closely what his cost of production will be for a cetrain crop. A monetary value is shown for two items, namely rent and taxes and use of machinery. These may be too low under present day conditions. In cost of production studies, a value for rent is obtained by multiplying the value of the land (value of farm divided by number of acres in farm) by the current rate of interest as obtained on first mortgages. To this amount is added the amount of the taxes per acre.

Table 26 shows the yields per acre of various crops. However, the yields in green weight as given for corn and swedes are not indicative of their feeding value because of the high percentage of moisture in these crops. Since the moisture in crops is of no particular value, a better way of comparing crops would be on the basis of yield of dry matter per acre, that is the yield of the crop after all the water has been excluded. However, there is still some variation in the nutritive value of the dry matter from different crops. Therefore, probably the best criterion for comparing the value of a number of crops to the total digestible nutrients (T.D.N.) produced per acre. The term digestible nutirents covers that portion of the nutrient which is digested and taken into the body.

In a study of these data some interesting points are brought out. For instance, it may be noted that swede turnips produced the highest amount of digestible nutrients of the crops compared. It must also be noted, however, that it requires considerably more hours of manual labour to produce one ton of digestible nutrients from swede turnips than it does from other crops. This explains why root crops are not extensively grown for livestock feed. However, swedes are a dependable crop which require a minimum amount of expensive machinery, and if the labour is available on the farm, actually require a minimum amount of cash expenditure.

Corn silage or clover silage have not replaced roots as a source of succulent feed for livestock, due to a combination of reasons. The production of corn silage requires a heavy initial outlay for a silo and machinery. This, plus the fact that many areas in New Brunswick are not suitable for corn growing, would indicate that corn for silage will not be extensively grown in this province, at least not until more suitable varieties or hybrids are introduced. The production of clover silage also requires expensive machinery. The lower yields per acre secured from clover considering the labour involved in handling the green crop often result in a high cost per ton of clover silage obtained. Winter-killing also often reduces the clover stand drastically and unless considerable ground limestone is used, it would be very often difficult to obtain a sufficiently large acreage of clover. In view of these difficulties, it appears unlikely that clover will become widely used for ensilage.

HORTICULTURE

TREE FRUITS

R. G. White and L. C. Young

APPLE VARIETY RECOMMENDATIONS

During the period, 1937-1947 inclusive, a total of 135 varieties of apples have been under observation in the test orchards. The results of these investigations in conjunction with the advice of officials of the Provincial Department of Agriculture form the basis of the following variety recommendations.

From the standpoint of apple growing, the province of New Brunswick may be divided into two main districts.

District I.—This is the main commercial area and comprises the favourable sections of the counties of Albert, Carleton, Charlotte, Kent, Kings, Queens, Sunbury, York, and Westmorland. Although recommendations are made for this entire area, it is generally recognized that varieties of questionable hardiness will be more apt to thrive in the lower Saint John River Valley, south from Gagetown and in certain sections of Charlotte, Albert and Westmorland counties.

District II.—This district comprises the counties of Gloucester, Madawaska, Northumberland, Restigouche, Saint John and Victoria and also those areas in District I which are not suitable to the growing of apples on a large scale. Apple growing in District II is largely confined to home orchards.

Variety recommendations for the two districts, together with bloom and harvest dates, and notes on the storage season are given in Table 27 and Table 28.

Variety recommendations have been narrowed down to a relatively few varieties. Twelve varieties are mentioned for District I. In making selections

TABLE 27.—APPLE VARIETY RECOMMENDATIONS FOR DISTRICT I
(The more favourable sections of the counties of Albert, Carleton, Charlotte, Kent, Kings, Queens, Sunbury, York and Westmorland.)

Variety	Bloom Dates[1]	Date of Harvest[1]	Season
Summer			
Crimson Beauty	May 22—June 2	Aug. 7—Aug. 22	A few days
Melba	May 25—June 4	Aug. 29—Sept. 10	10-14 days
Early McIntosh[2]	May 27—June 5	Sept. 6—Sept. 12	2 weeks
Milton[2]	May 27—June 6	Sept. 12—Sept. 24	3 weeks
Joyce[2]	May 26—June 5	Sept. 22—Sept. 30	Oct. 1—Oct. 20
Fall and Early Winter			
Lobo	May 27—June 8	Sept. 26—Oct. 5	Oct. 15—Dec. 15
Cortland	May 27—June 7	Oct. 4—Oct. 12	Nov. 15—Jan. 15
McIntosh	May 26—June 4	Sept. 28—Oct. 5	Nov. 1—Jan. 1
Mid and Late Winter			
Macoun[3]	May 27—June 8	Oct. 6—Oct. 14	Dec. 15—Feb. 15
Linda[3]	May 27—June 5	Oct. 5—Oct. 11	Dec. 15—Feb. 15
Sandow	May 27—June 9	Oct. 15—Oct. 20	Jan. 1—Mar. 31
Lawseed[3]	May 28—June 10	Oct. 15—Oct. 20	Feb. 1—April 30

[1] The above dates of bloom and harvest are as recorded at the Dominion Experimental Station, Fredericton, N.B., and are fairly representative of the middle Saint John River Valley. In eastern New Brunswick and in District II, the dates are considerably later.
[2] For limited trial only.
[3] For extended trial.

TABLE 28.—APPLE VARIETY RECOMMENDATIONS FOR DISTRICT II

(The counties of Gloucester, Madawaska, Northumberland, Restigouche, Saint John and Victoria, including areas in the counties of District I less suitable to the commercial growing of apples.)

Variety	Bloom Dates[1]	Date of Harvest[1]	Season
Summer			
Crimson Beauty	May 22—June 2	Aug. 7—Aug. 22	A few days
Yellow Transparent	May 24—June 4	Aug. 10—Aug. 20	A few days
Melba	May 25—June 4	Aug. 29—Sept. 10	10-14 days
Duchess	May 25—June 5	Aug. 16—Sept. 6	2 weeks
Fall and Early Winter			
Dudley	May 26—June 6	Sept. 8—Sept. 26	Until Nov. 15
Alexander	May 28—June 8	Sept. 20—Sept. 30	Until Nov. 30
Lobo	May 27—June 8	Sept. 26—Oct. 5	Oct. 15—Dec. 15
Wolf River	May 28—June 7	Sept. 28—Oct. 10	Until Jan. 15
Cortland	May 27—June 7	Oct. 4—Oct. 12	Nov. 15—Jan. 15
McIntosh	May 26—June 4	Sept. 28—Oct. 5	Nov. 1—Jan. 1
Mid-Winter			
Milwaukee	May 26—June 6	Sept. 26—Oct. 6	Dec. 1—Feb. 15

[1] The above dates of bloom and harvest are as recorded at the Dominion Experimental Station, Fredericton, and are fairly representative of the middle Saint John River Valley. In Eastern New Brunswick and in District II, the dates are considerably later.

from this list, individual growers will differ considerably and will be influenced by such factors as location, market facilities, previous plantings and to no small extent, personal preferences. In general, however, plantings in the near future should consist largely of McIntosh and Cortland with a few other varieties added to ensure satisfactory pollination and to serve special markets. The variety Sandow should be planted much more extensively and should be double-worked except in the most favourable districts.

APPLE VARIETY TRIALS

The determination of the ultimate value of an apple variety requires many years of trial and observation. Of the 135 varieties of apples under trial during the past ten years, only twenty are worthy of consideration for purposes of planting at the present time. Most of the other varieties do not appear to have any value, although the position of a few is still debatable. The following varieties are in the forefront at the present time: Crimson Beauty, Cortland, Early McIntosh, Joyce, Lawseed, Linda, Lobo, Macoun, McIntosh, Melba, Milton, Northern Spy and Sandow. An additional seven varieties: Bancroft, Edgar, Hume, Keetosh, Kendall, Lawfam, and Petrel are also under close observation.

McIntosh is too well known to warrant additional comment. It still remains New Brunswick's premier apple variety.

Cortland is establishing itself without any undue promotion as a popular variety among the growers. The tree is hardy and vigorous. The fruit is attractive and of good quality, although not equal to McIntosh in either respect. The season is two weeks later than McIntosh. It comes into bearing early and is an annual bearer, producing heavy crops. The following yield records suggest that Cortland at least approaches McIntosh in yielding ability. The average annual yield for the period 1937-1945 inclusive of ten Cortland trees, planted in 1924, has been 2·42 barrels per tree. The average annual yield for the same period of ten similar McIntosh trees planted in 1923 has been 2·58 barrels per tree. These results, although not strictly comparable, at least suggest that Cortland must be classed as a heavy-yielding variety.

Crimson Beauty and Melba are grown to supply an early local market. The existing market is able to absorb the present crop and possibly could utilize more, especially of Melba. Thinning practices and preharvest sprays have largely overcome the inherent weaknesses of these varieties to be somewhat undersized and to drop before becoming fully coloured.

Early McIntosh, although of excellent appearance and moderately good quality, has a very short season and is distinctly biennial in bearing. To date, it gives evidence of being a low-yielding variety and lacking in size. Coming at a season just after Melba, it may be useful under some conditions.

Joyce is a fall apple of moderately good quality as grown at Fredericton. It is ready to harvest during the third week in September and is at its best from October 1 to October 20. This brings the variety on the market just prior to McIntosh. The tree is sturdy, winter hardy and easy to pick and spray. It comes into bearing at an early age and is distinctly biennial in bearing habit, producing a heavy crop in the fruiting year. The apples lack somewhat in colour, being striped in appearance, but pack out well, due to their uniformity of shape and excellent size. They appear to be less subject to diseases and insect pests than McIntosh. Joyce is a variety that should be given further trial for the local market.

Milton follows Early McIntosh in season. It is a good yielding variety with moderately good quality but lacks uniformity of shape. In certain seasons, the fruit is extremely attractive. At other times, it definitely lacks appearance and sales value. A limited number of growers may find this variety profitable.

Northern Spy is a well known variety of great importance in other sections of Canada. It has not achieved widespread popularity in New Brunswick, owing to its lack of winter hardiness, its failure to colour well in all seasons and its tendency to bitter pit. In spite of these defects, it is being grown as a high quality, late winter variety in the more favoured sections of the province.

Sandow is a late winter variety, extending in season in common storage until the end of March. Attractive in appearance and of excellent quality, this variety has no serious competitor in its season. The tree is hardy under average winter conditions but has been injured during test winters that occur at intervals of ten to twenty years. For this reason, Sandow should be double-worked except possibly in the most favourable districts of the province. The upright nature of growth, particularly of the younger trees and the long unbranched limbs do not make for an attractive tree. Nevertheless, the trees are capable of carrying heavy loads of fruit without undue breakage. Young trees begin to fruit in seven years and rapidly increase the size of the crop as the years progress. A yield of thirteen pecks has been secured from an eight year-old tree. Yields are somewhat lower than McIntosh, six trees averaging 16·64 pecks during the past nine years as against 19·33 pecks for six McIntosh trees grown under similar conditions. The apples are somewhat subject to bitter pit, but this condition has never become at all serious. In spite of the above criticisms, the good qualities of Sandow render it worthy of extensive commercial planting.

Lawseed is a late winter variety, extending in season in common storage until the end of April. To date, the tree appears to be hardy. The fruits, although not highly coloured, are attractive, since the colour is uniformly distributed over the entire surface of the apples. Although not a good quality desert apple, it has considerable palatability. Moreover, it is a good cooking variety. Reports have been received that Lawseed has a tendency to run small in size. This habit has not been noticeable at this Station. It is a good cropper and fills a gap late in the season when no other local apples are available.

Linda is a handsome winter apple of good quality which is in season from January until March. It comes into bearing early and produces heavy crops. There is a tendency for many of the trees to form weak crotches and to break with heavy loads. Because of this fact, as well as its questionable hardiness, the double-working of this variety is recommended. At this Station, the fruit rots badly in common storage. At Ottawa, it is reported as being an excellent cold storage variety. Owing to its attractiveness, quality and cold storage record, every grower should have some Linda on trial.

Lobo is a late fall and early winter apple that has failed to achieve wide popularity by a narrow margin, chiefly because McIntosh is in season when Lobo is at its best. The tree is sturdy, well branched, very winter-hardy and easy to pick and spray. Like Joyce, it comes into bearing at an early age, is practically biennial in bearing habit but bears a heavy crop in the fruiting year. The apples are almost solid dark red in colour, very attractive, are of excellent size and pack out well. The quality is good, the flesh being crisp, juicy and of good flavour. This variety is valuable for the colder districts and should be planted extensively where McIntosh is not hardy.

Macoun is a highly coloured variety of excellent texture and definitely later in season than McIntosh. In spite of its very mild flavour, it is liked by many on account of its crisp, melting flesh and its abundant juice. In the early years, over-sized Macoun apples, produced on top-grafted trees, broke down badly in storage. This has not occurred to any extent since 1940. The tree is hardy, vigorous and sturdy. It is quite biennial in habit but sets a very heavy crop in the fruiting year. The apples tend to bunch on the trees, thus affording a harbour for insect pests. It can also be criticized in that the fruit is slightly under-sized on mature trees.

Bancroft is a winter variety that remains in good condition until the end of March. The tree is strong and vigorous and may be perfectly hardy, although it has shown some slight indication of injury of a questionable nature. No yield records are available as the trees are only ten years old. The fruit is generally well coloured, juicy, crisp and above average in quality. The size, although not large, is sufficient for the trade. Under local conditions, the apples russet badly. This is thought to be due to the lime sulphur used in the spray program. At Ottawa, where mild sulphurs are used, this does not happen, the apples being well blushed with red. Bancroft may interest those growers who are hesitant about planting Sandow or Linda.

Kendall is a vigorous, strong growing variety with season extending to the end of February. It bears early and produces heavy crops. Ten-year old trees appear perfectly hardy. The fruit is above medium in size, solid dark red in colour, of good texture and with greenish flesh. Highly thought of in some quarters, the apples as grown at Fredericton definitely lack quality.

Lawfam is a debatable variety which has been under trial for a number of years. It is sensitive to soil conditions and has a narrow range of adaptation. The tree is medium in hardiness and is not a heavy bearer. The apples are solid dark red in colour, moderately attractive, but slightly on the small side. The flesh is moderately crisp and juicy, but usually only medium in quality. In season from December until the middle of February, Lawfam has not attracted sufficient attention to be recommended for commercial planting.

Keetosh is a late fall apple of good quality that ripens unevenly and drops readily. Although often poorly coloured, some of the fruits are attractive but tend to be under-sized. The tree is well shaped, hardy and a very heavy cropper. If thinned carefully and sprayed to control dropping, Keetosh might be useful as a variety to precede McIntosh until a better variety is developed.

Edgar is a mid-winter variety of questionable hardiness. It is an open-type tree and slow in coming into bearing. The fruits are medium to above medium in size, well coloured, of good quality but lacking in flesh texture to be classed as excellent. Apart from its quality, Edgar is not considered to be particularly promising at the present time.

Hume is a variety that has shown promise in other parts of Canada. It is solid dark red in colour, above medium in size and where well grown is of good quality. It is a short season apple, ready to harvest during the last week in September, definitely preceding the McIntosh. Its performance at Fredericton has been none too satisfactory but the observations were made on only one tree. It is recommended for trial largely because of its performance in other places.

Petrel is an early fall apple, approximately two weeks later in season than Melba. Although of excellent quality, this variety has a very serious weakness in that it is always very poorly coloured but can be marketed because it is in season at a period when good quality apples are scarce.

POLLINATION

Where the intention is to plant a large orchard, some provision should be made for an adequate pollination of the blossoms. This is necessary because only a few varieties of apples are completely self-fertile and others like the McIntosh are self-unfruitful to their own pollen and must be cross-pollinated to produce satisfactory commercial yields. Where a large number of trees of any variety are planted in one block, it is advisable to include a sufficient number of one or more other varieties in the planting to act as pollinators. For practical purposes, one row of trees in five should be of the pollinating variety. Since McIntosh and Cortland are the two main commercial varieties in New Brunswick, it is important to know that each is a satisfactory pollinator of the other. However, since Cortland blooms about a day later than McIntosh, it is essential to include an earlier blooming variety, such as Melba, to ensure satisfactory pollination of the early blossoms of McIntosh. Other satisfactory main pollinators of McIntosh are Lobo, Wealthy and Fameuse and on the basis of work elsewhere, Early McIntosh, Macoun and Milton. Generally speaking, an ideal pollinator should come into bloom one day before the variety to be pollinated. A study of the blooming period of twenty of the more promising varieties of apples for New Brunswick has been made at the Station, covering a period of the past ten years. Figure 12 shows the average date the varieties came into bloom, the date of full bloom and the date bloom was over.

PRE-HARVEST SPRAYS ON APPLES

The tendency of many varieties of apples to drop heavily before they are fully mature prompted a trial of the use of Parmone, a commercial naphthalene acetic acid preparation as a means of reducing the pre-harvest drop of McIntosh apples. Twelve trees were selected, six of which were treated and six of which were left unsprayed as checks. In order to obtain reasonably uniform conditions, six series of two trees each were selected, each pair of trees being uniform from the standpoint of fertilizer treatment, size, vigour and the crop they were bearing. In each series, one tree was sprayed with Parmone, the other serving as a check. Each day afterwards for twenty-five days the windfalls were picked up and their number counted. The results are graphically portrayed in Figure 13.

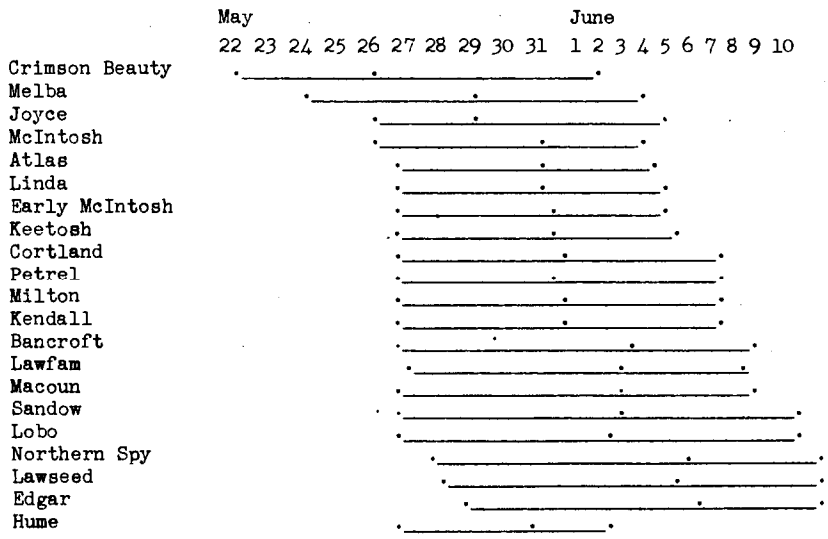
The results indicate that the Parmone spray had a definite effect on the rate of drop of McIntosh apples. Computed on the basis of the percentage of the total crop that fell off each day, it became clear that the Parmone began to exert an influence on the fifth day and remained effective up until and including the eighteenth day after treatment. After the eighteenth day, the percentage of

windfalls falling from the treated trees was greater than from the untreated trees, due largely to the fact that there were more apples remaining on the treated trees.

The rapidity with which the material became effective after application varied considerably between the series, ranging from two to eight days. The length of time it remained effective was from fourteen to twenty-five days being the most effective from the eighth to the thirteenth day and in some instances as late as the seventeenth day after treatment.

Figure 12 AVERAGE BLOOM PERIOD OF 21 VARIETIES OF APPLES

FREDERICTON, N. B. 1936-1947



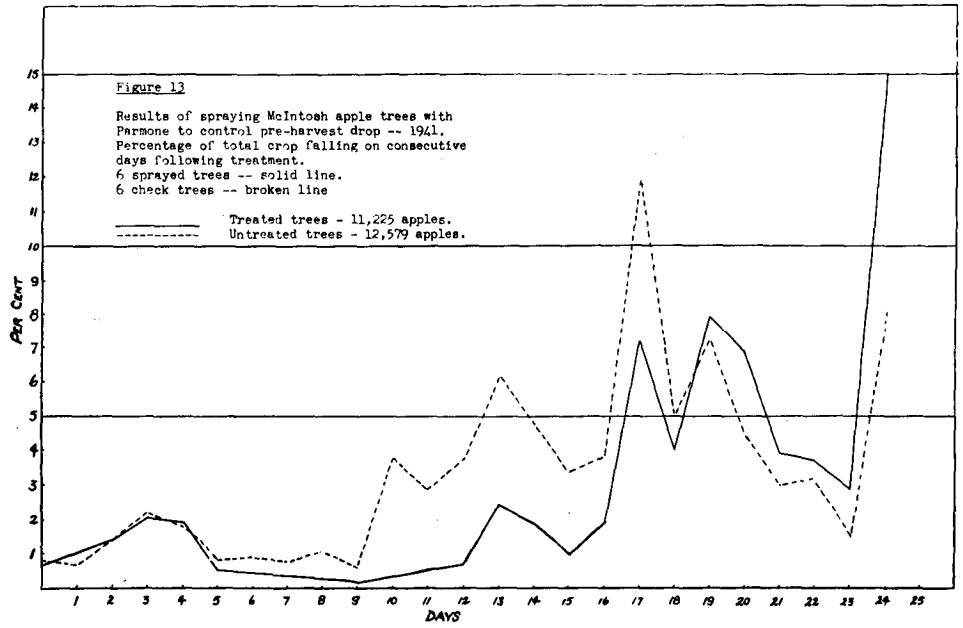
Crimson Beauty, for example, begins blooming May 22; it is at full bloom May 26; and bloom has fallen June 2.

Later usage of Parmone, while not of an experimental nature, has clearly substantiated the results obtained in 1941. It has been used successfully on such varieties as Crimson Beauty, Melba, Petrel, Keetosh, Linton and McIntosh. Applied as soon as a few apples begin to fall, it has definitely reduced the number of windfalls, thereby improving the size, colour and quality of the crop. The effect is so pronounced on early varieties that they will become over-mature and crack open rather than fall off normally.

WINTER VARIETIES OF APPLES

In response to a request by the New Brunswick Fruit Growers Association, an apple orchard consisting of winter varieties only was set out in 1935. This orchard consists of the following varieties: Bancroft, Cortland, Edgar, Gerald, Kendall, Macoun, Macwood, McIntosh, Medina, Lawfam, Linda, Lawseed, Orleans, Sandow, Red Spy and Rome Beauty. There are also a number of double-worked Antonovka trees which will be discussed later under the heading: "Tree Building".

Table 29 summarizes the observations made on the trees during the 1935-47 period. Varieties like Gerald, Kendal, Macoun, Lawseed and Sandow have so far turned out to be quite hardy whereas more tender varieties like Macwood, Linda, Lawfam, Medina, Orleans and Rome Beauty have died out in varying numbers. In between these two groups is a class intermediate in hardiness, consisting of the varieties Bancroft, Edgar and Red Spy, each of which has only lost one or two trees due to some inherent weakness in the trees such as lack of hardiness, a weakness in mechanical structure or a swelling of the stock and scion union. Although the trees are young and have not up to the present passed through a test winter, there is evidence that some of the varieties at least would be of questionable use commercially.



Figures on minimum age to fruiting should be taken with reservation as this orchard was planted on a pasture soil low in fertility. On good land these figures might be reduced by one or two years.

This experiment so far further demonstrates the need for continued study of apple varieties. In the group of varieties referred to above, McIntosh, Cortland and Sandow are outstanding. Among the others are several with some future. In this class may be placed Bancroft, Macoun and possibly Linda and Lawseed. The remainder are questionable for a number of reasons. Some lack winter hardiness, others lack yielding ability and quality of fruit. Still others have poor tree conformation. With Sandow performing as it has, this variety should be given extensive trial to see how it will perform commercially.

APPLE BREEDING

One of the factors limiting the rapid expansion of apple orcharding in New Brunswick is the lack of suitable varieties covering the entire apple season from early autumn to late winter. At the present time, the majority of the plantings consist of the varieties McIntosh and Cortland, varieties that are in season from late October to early in January. Other seasons, particularly late winter are not adequately supplied.

TABLE 29.—PERFORMANCE OF WINTER VARIETY ORCHARD
1935-1947

Variety	Number of trees originally planted	Number of original trees thriving in Nov. 1947	Number of trees lost, replaced or unthrifty due to		Minimum age to fruiting 1 pk. or more	Relative hardiness	Tree conformation	Season of fruit	Quality of fruit	Commercial value
			Inherent factors	External factors						
Bancroft	6	5	1	0	8 years	Moderately hardy	Bushy—strong	Jan.—Mar.	Medium to good	Fair—Might make promising mid-winter apple.
Cortland	6	5	1	0	7 years	Hardy	Pendulous—strong	Oct.—Jan.	Good	Excellent.
Edgar	7	5	2	0	12 years	Slightly tender	Erect—rather open	Dec.—Feb.	Good	Slow to come into bearing; light cropper.
Gerald	7	7	0	0	7 years	Hardy	Erect—strong	Oct.—Jan.	Fair	Hardly enough quality; heavy cropper.
Kendell	6	6	0	0	8 years	Hardy	Erect—strong	Nov.—Jan.	Ordinary	Hardly enough quality. Crops well. Excellent colour and size.
Macoun	6	5	0	1	8 years	Hardy	Erect—strong	Nov.—Jan.	Good	Promising, crops well, short season. Excellent colour. May run to small sizes.
Macwood	6	4	2	0	9 years	Tender	Erect—strong	Dec.—Feb.	Poor	?
McIntosh	6	2	2	0	7 years	Hardy	Spreading but strong	Oct.—Jan.	Excellent	Excellent.
Medina	5	3	2	0	8 years	Tender	Spreading but strong	Jan.—Mar.	Fair to good	? Heavy skin. Lacks colour.

Lawfam.....	13	6	4	3	8 years	Medium hardy	Spreading, rather open	Jan.—Feb.	Medium	? Shy bearer. Tree does not thrive on some soils.
Linda.....	9	5	4	0	7 years	Tender	Poor—breaks easily	Jan.—Mar.	Excellent	Good on limited scale.
Lawseed.....	6	5	0	1	8 years	Hardy	Erect—strong	Mar.—Apr.	Fair	Fills a place as a late winter apple.
Orleans.....	5	2	3	0	7 years	Tender	Erect—strong	Mar.—Apr.	Fair to good	Tree too tender.
Sandow.....	6	6	0	0	8 years	Slightly tender	Long branches few side twigs	Feb.—Apr.	Excellent	Excellent if tree had better conformation. Hardiness not proven.
Red Spy.....	6	3	1	2	11 years	Slightly tender	Very erect—bushy	March	Ordinary	?
Rome Beauty.....	5	0	5	0	8 years	Tender	Pendulous—open	April	Poor	?

Apple breeding at the Experimental Station has been in progress since 1926. Since that date, some 5,459 seedlings have been planted out, comprising a large number of both controlled and open pollinated material. Many of the crosses have the variety McIntosh as one parent.

The oldest seedling orchard has now been in existence some eighteen years and younger orchards have been planted more recently. At the present time, 2,935 trees have been discarded as having poor quality fruits, 1,302 trees have been lost for various reasons and 1,222 trees are still living. Some 3,461 trees have fruited to date, from which 34 seedlings have been selected as showing promise as possible new varieties. These 34 seedlings vary in appearance, size, texture and quality but they all show considerable promise in one or several aspects. Some of them are summer apples, others are early winter to mid-winter types. Desirable late winter sorts have been few and most of these have lacked quality.

The more promising of these apple seedlings have been marked for propagation to secure trees for a second trial and for distribution. A few trees have been distributed to outside growers but are not yet of an age from which to gather information.

Tree Building

The great weakness of many otherwise desirable varieties of apples is the susceptibility of the trees to winter-injury and to mechanical breakdown through effective crotches. In an attempt to forestall such occurrences, a process of tree building known as double-working has been under investigation at the Experimental Station since 1940. The purpose of this tree building is to study the effect of top working less hardy but desirable varieties of apples upon hardy, sturdy varieties of less commercial promise. In preparation for this work, small orchards of from 60 to 175 trees were planted at various places throughout the province

Figure 14—Double-working fruit trees is an insurance against winter injury and broken branches.

of New Brunswick. One orchard known as the Winter Variety Orchard is located at the Experimental Station, another at Queenstown and four others on the Illustration Stations at Black River Bridge, Cumberland Bay, Currieburg and Pomeroy Ridge. This provides for a wide range of climatic conditions. Selected varieties of no commercial value, but with extremely hardy wood and strong wide-angled crotches were planted to form the trunk and main scaffold branches of the future trees. When these trees have reached a convenient size for bud grafting or frame-working, the tops of them are budded or grafted to the commercial variety it is desired to study. Hardy stocks in use at the present time include Antonovka, Virginia Crab, Anaros, Hudson Seedling, Columbia, *Malus robusta, Malus robusta* No. 5 and Hibernal. Grafted on these hardy stocks are various commercial varieties including McIntosh, Sandow, Linda, Bancroft, Lawseed and Red Spy. Each orchard contains standard or single-worked trees of the above mentioned commercial varieties to serve as checks for purposes of comparison.

On the basis of winter hardiness, a comparison of the two methods of establishing an orchard is not yet possible, as the trees are too young. From the standpoint of weak limbs, the double-worked trees have not broken down as yet, whereas a few breakages have already occurred on the single-worked trees.

A few observations on the work stand out above all others. Top working the hardy stocks has in the main, been relatively simple and successful either by bud grafting or by frame-working. However, it has been observed that scions of Linda, Sandow, Lawseed and Red Spy have proved incompatible on Hudson Seedling stock. McIntosh and Bancroft have so far done well on this stock. Several varieties appear to be outgrowing their stocks. *Malus robusta* produces spindly growth which is slow to reach sufficient size for grafting.

ORCHARD NUTRITIONAL INVESTIGATIONS

A comprehensive investigation into a nutritional disorder in a local apple orchard was conducted during the years 1936 and 1943 inclusive.

This thirty-year-old orchard, situated on the farm of Ellis Kelly, Springhill, N.B., was in critical condition at the time the work began. Upon examination, it was found that in general, the trees had made practically no terminal growth for several years and in appearance were open in character and lacking in foliage. Moreover, many trees contained dead and dying limbs and several trees were completely dead. The foliage was small, very pale green in colour and subject to marginal scorch in many sections of the orchard (Figure 15). An enquiry into the fertilizer practice followed in this orchard revealed the interesting fact that nitrogen only had been applied over a long period of years and that the grass had been cut and always removed as hay.

Chemical tests showed the soil to be very low in potassium, phosphorus and magnesium. It was also quite acid. Leaf samples from affected trees showed a very low potassium content as compared with those from normal trees. A number of other factors were also observed. During the latter part of May, the water-table in many sections of the orchard was within six inches of the surface. A study of the root penetration revealed the fact that the bulk of the roots were confined to the surface twelve inches of soil, with practically no large roots between the twelve- and eighteen-inch levels, at which lower level, a hard impervious subsoil was encountered.

A comprehensive fertilizer experiment, studying the elements nitrogen, phosphorus and potash applied at various rates, both singly and in combination, straw and manure mulches, and boron and magnesium applications was conducted for several years. Methods of application included soil applications of various types, sprays and injection of various elements, in both the wet and dry form, directly into the branches of the trees.

Owing to the wide range of treatments, it is difficult to report on a project of this character, since conclusions are based largely upon general observations. However, a perusal of the data collected on the various combinations of nitrogen, phosphorus and potassium indicate that heavy applications of nitrogen have produced the most marked response. Leaving out the effect of potassium, Figure 16 demonstrates in graph style the effect of low, medium and high applications of nitrogen.

This graph clearly indicates that the applications of nitrate of soda, at rates up to seven pounds per tree, whether applied alone or in combination with other elements, are insufficient to produce marked improvement in tree vigour. With low nitrogen application, sixty-six per cent of the thirty-eight trees under observation showed no improvement, and only 2·5 per cent real improvement, whereas with high nitrogen only 17·6 per cent of the seventeen trees under observation showed no improvement and 41·2 per cent real improvement. The fact that 17·6

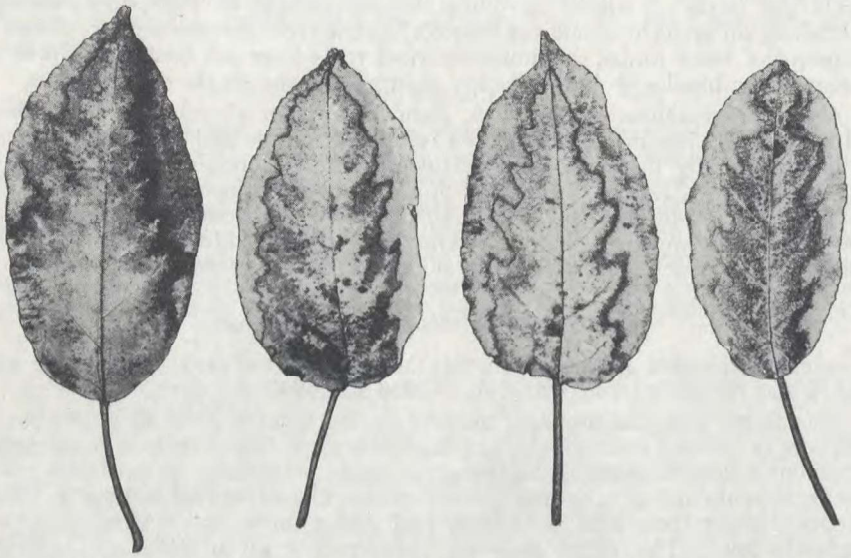


Figure 15—Apple leaves, showing severe marginal scorch, from orchard owned by Ellis Kelly, Springhill, N.B.

per cent of the trees receiving high nitrogen showed no improvement, indicates the complexity of the problem and also suggests that nitrogen deficiency is not the only limiting factor in tree growth in this orchard. That it is probably the most important factor is shown by the fact that trees receiving low nitrogen for several years and showing little if any improvement over this period when given high nitrogen immediately began to show a very definite response in tree vigour in the great majority of cases.

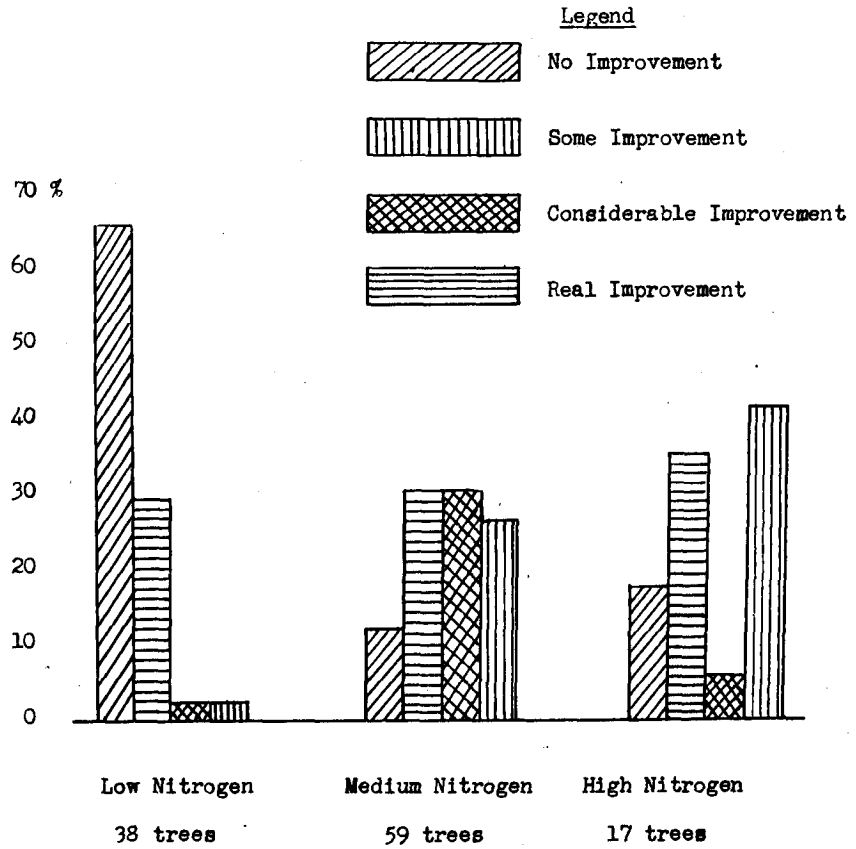
The response to potash applications has not been outstanding, but when combined with high nitrogen, there appears to be a tendency for the potash to increase leaf size and to increase the lustre of the leaf. No response has ever been noted from the use of phosphorus, whether used in small or large amounts. As a matter of fact, large quantities of from twenty to twenty-five pounds of superphosphate per tree appeared to definitely reduce leaf size.

The broadcast method of applying the minerals was just as effective as the more laborious practices.

Results from the use of borax and magnesium have been variable. On some trees, magnesium has appeared to give a definite response, on other trees the results were not so marked. Borax has in general, produced an abundance of thick foliage.

Trees treated with manure made slower but steady improvement, showing that the reaction to moderate amounts of barnyard manure is positive, but slower than from quick acting nitrogenous fertilizers.

Figure 16 - EFFECT OF LIGHT, MEDIUM AND HEAVY APPLICATIONS OF NITRATE OF SODA TO FULL GROWN McINTOSH APPLE TREES, 1937-1943



Two outstanding facts are noticeable in this study. This orchard, which at the beginning of the investigations was thought to be dying, has staged a remarkable comeback and is now producing heavy crops of fruit. Moreover, it has been established that trees in a condition such as existed in this orchard can withstand very heavy fertilizer applications. Although not recommended for practical use, applications of twenty-five pounds of nitrate of soda, twenty-five pounds of acid phosphate and twenty-five pounds of muriate of potash have resulted in marked improvement of the trees. In only one case did this amount of fertilizer prove detrimental to the future vigour and appearance of the tree.

The results of overcrowding of trees were very apparent. Several thirty-five-year-old trees were badly intergrown and definitely lacked vigour, particularly in the lower half of the trees. This condition was not overcome by the application of fertilizer, even in excessive amounts.

As a result of these observations, the disorder was ascribed to a combination of factors, including nitrogen and potash deficiency, winter injury, shallowness of soil and a high water-table due to poor drainage.

In old orchards grown under heavy sod, nitrogen is most likely to be the limiting factor. Applications to mature trees of less than ten pounds of nitrate of soda or its equivalent in other nitrogenous fertilizers, are inadequate. The advisability of applying a complete fertilizer containing nitrogen, phosphorus and potash to the growing orchard is strongly urged as an insurance measure against the occurrence of nutritional disorders in the later life of the orchard.

Small Fruits

R. G. White

STRAWBERRY VARIETY TESTS

The strawberry continues to be a very important fruit crop in New Brunswick, the annual yield often exceeding one million quarts.

Success with this crop is enhanced by the adaptability of the varieties to the district in which they are grown and by the reception which these varieties receive when put on the market. Size, firmness, colour, texture and quality of berry determine the reaction of the trade. Yielding ability and early maturity rank first with the grower.

Senator Dunlap has been the most widely grown variety in the province for many years. This variety, however, has a number of defects, including a dull appearance upon arrival at market and a lack of firmness in the berry which adversely affects its handling quality. It is part of the work of the Experimental Station to conduct variety trials and evaluate new introductions which are developed by the plant breeder. Eighty-nine varieties or seedlings have been tested since 1936, many of which have been considered inferior to Senator Dunlap and not worthy of extensive propagation. A few varieties have survived preliminary tests and are now being subjected to replicated yield trials and distribution to determine the place they will take in the commercial areas. In this group are the varieties Valentine, Premier, Mackenzie, Senator Dunlap, Catskill, Dorsett, Fairfax, Louise and Elgin in order of season. In addition to these, eleven new varieties recently introduced are still under observation along with seven unnamed seedlings.

Valentine has proved to be the earliest variety grown. It is a vigorous plant maker, with rugged healthy foliage and dark, glossy, very firm fruit of medium size, but lacking in quality. It has ripened fully fifty per cent of its crop during the first week of the picking season and to date has given yields which have exceeded the 7,000 quarts per acre figure. This variety lacks quality and loses size rapidly once the earlier berries are harvested but because of its earliness, firmness and yielding ability will probably become important commercially.

Premier has been saved because of its earliness. When well grown it produces attractive fruit which ripens only a day or two later than Valentine and the berries are slightly firmer and brighter in appearance than Senator Dunlap. Up to the present time, yields have been somewhat lower than for Senator Dunlap, a condition which may be due to the variety not being a prolific plant maker. Spacing the rows three feet apart, rather than the regulation four feet, might compensate and make up for the difference in cropping ability.

Catskill, Dorsett and Fairfax are all mid-season varieties, vigorous plant makers and have rugged healthy foliage. The fruits of each are large, attractive, firm and of good quality. Fairfax is darker in appearance than the other two, has a sweeter taste but gives a lower yield. It should be valuable for home gardens where quality is paramount. Catskill, while good, is inferior to Dorsett and Fairfax in quality but is reputed to be a heavier cropper than the others. Dorsett is a fine quality variety which has been criticized by the growers as not being a heavy cropper. Replicated yield trials at Fredericton have tended to contradict this observation, the variety having yielded at the rate of 6,000 or more quarts per acre.

Mackenzie is probably the best variety yet introduced by the Experimental Farms Service. A vigorous grower and productive plant maker, also a good cropper, Mackenzie has shown considerable promise for a number of years. The berries are medium early, large, bright and attractive, less acid than Senator Dunlap, have about the same degree of firmness and are only slightly below the Dunlap in quality. It has been well received by commercial growers.

Louise and *Elgin* are two of the best late maturing varieties yet tried. Louise produces large, attractive, dark red, firm fruits of fair quality. Unfortunately, it is an imperfect variety, requiring cross-pollination, is very subject to leaf-spot, none too vigorous a plant maker and to date not a prolific cropper. Elgin is superior to Louise in that it is a perfect flowering variety relatively free from leaf-spot. The fruits are large, pale red in colour, probably not so high in quality and the variety is only a medium cropper. Both varieties appear to make small plants with the berries lying very close to the ground. Although grown commercially, neither variety has as yet become of any particular importance with the majority of growers.

Preliminary observations indicate that several of the very recent introductions appear promising. Among the best of these are Fairpeake, Midland and Redwing and five unnamed seedlings from the Central Experimental Farm, namely 0-231, 0-261, 0-292, 37-20-04 and 37-35-C47..

RASPBERRY VARIETY TEST

The raspberry is another small fruit that is of economic importance in the province. As with the strawberry, the varieties grown commercially have their weaknesses and attempts are always being made to find superior varieties that can be recommended for commercial production. To this end, variety trials are conducted for the purpose of determining the adaptability and usefulness of the newer productions. Two new plantations were set out during the past twelve years, one consisting of a group of named varieties and another consisting of ten recent introductions from the Central Experimental Farm, Ottawa.

The best of the named varieties appear to be Viking, Newman 23 and Latham with preference divided according to conditions. Newburgh, a newer variety with a promising reputation, failed to show sufficient winter-hardiness and suffered severe winter-killing.

The group of ten Ottawa seedlings contained some interesting material. The best of these are now named Rideau, Trent, Madawaska, Ottawa and Gatineau respectively. Rideau and Ottawa produce the best quality berries for the fresh fruit trade, followed by Trent. Unfortunately all of these have suffered from winter-killing, Rideau in particular being quite tender. They have been killed back much more severely than has the Viking, a very satisfactory commercial sort that has the reputation of not being too hardy. Madawaska has been quite hardy and Gatineau moderately so, but neither of these varieties

have the appearance of Rideau and Ottawa. A new propagation bed of these five varieties has been set out for the purpose of producing canes for distribution to other sections of the province.

Since these varieties are definitely promising in many respects, it is hoped that they will eventually prove to be hardy in certain other sections of the province.

Vegetable Production

R. G. White

SWEET CORN VARIETIES FOR NEW BRUNSWICK

The introduction of many new varieties of sweet corn in recent years lends added interest to the corn variety trial. Factors which carry the most weight in selecting a sweet corn variety are season of maturity, size of ear, cropping ability, quality and appearance. Where the growing season is relatively short, as in New Brunswick, early maturity is very important. The market also desires ears of good size, appearance and quality and the grower looks for a heavy yield per acre.

Forty-five different varieties or strains have been grown at Fredericton since 1936, confining the tests largely to yellow strains since white kernels are not in demand. Based upon the above mentioned characters, a number of these have been selected as suitable for New Brunswick conditions.

Dorinny, Banting, Seneca 60 and Northland Sweet are all early to medium early maturing, small eared varieties of high quality, which appear very suitable for home gardens or a selected trade which does not discriminate against a small ear. They have largely been discarded by growers catering to the larger trade which demand a variety with a medium-sized ear. These varieties however, have extended the frontiers of the corn-producing range to the colder, or coastal regions of the province, where hitherto sweet corn could not be satisfactorily grown. For instance, Seneca 60 is now being grown in sections which have too short a growing season to mature Golden Bantam. It does not give the yield of Dorinny which has been found to be the highest yielding and best quality sweet corn of any variety grown at Fredericton, but Dorinny although definitely earlier than Golden Bantam is generally ten days later in maturity than Seneca 60 and as such is not so suitable for short season areas. Dorinny also has more unsaleable ears than Seneca 60 which helps to detract from its popularity.

Varieties which appear suitable in the market garden areas of the province are, Spancross 13-4, Marcross 13-6, Golden Rocket, Earligold, Hybrid Golden Bantam and Golden Bantam. These varieties are in general early-maturing heavy croppers, produce good-sized ears and have sufficient quality to make them palatable.

Late varieties are not considered practical in New Brunswick, owing to the danger from early autumn frosts. The varieties tested have not exceeded earlier types in yield or quality. In order to extend the corn season, a late planting of an early or mid-season variety is preferable to the planting of a late variety.

TOMATO TRIALS

Variety trials with tomatoes are conducted to ascertain the commercial value of the various tomato varieties as offered by the trade when grown for a ripe fruit market, for canning or for pickles.

To be successful, a variety must yield well, be early-maturing, produce large enough fruit to meet the demands of the consumer, be well coloured and be free from growth cracks and other blemishes.

Thirty-one varieties have been grown since 1936, largely as non-staking types. A number of these appear well adapted to growing in New Brunswick and as such are worthy of mention. Included in this group are Labrador #66, Bounty, Victor, Bonny Best, Earliest and Best, Valiant, Stokesdale #4, Beston and possibly John Baer.

Labrador #66, Bounty and Victor are relatively new varieties that have come to the forefront in recent years. They all have large, attractive, smooth to slightly ridged fruits which are practically free from growth cracks, green shoulders and to a large extent russetting, although a certain degree of the latter has taken place with Bounty. The plants are determinate in character and produce sufficient foliage for the normal development of the fruit, but not enough to prevent a small amount of sunscald in hot, dry seasons. The fruit is pale green in colour before ripening and turns red slowly, particularly as the season advances. Once fully ripe, they are very attractive. Total yield is not so high as in later-maturing types but their suitability for an early ripe fruit trade is believed to be equal to any variety yet tested.

Among the indeterminate types which have done well at Fredericton are Bonny Best, Stokesdale #4, Earliest and Best, John Baer and Harkness. Mid-season in maturity, these varieties tend to be heavier croppers than a variety like Bounty, but do not ripen the quality of fruits before frost as do the earlier types. In themselves they fill a definite place as medium early to mid-season varieties which may either be grown for ripe fruit or as green tomatoes for pickles.

Varieties considered unsuitable for this are—Abel, Alacrity, Bestal, Globonnie, Herald, Pink #2, A-BB, Earlaina, Pink #1, Bidetown, Bison and Labrador Improved. They have either produced too large a percentage of rough cracked fruits or have been too small in size to command attention.

Borax Investigations

L. C. Young and R. G. White

During the past fifteen years, the role of the element boron in the nutrition of crop plants has been studied extensively throughout the world, and in this connection, this Station has made some notable contributions.

On this continent, the first instance of a proved boron deficiency was recorded by this Station working in co-operation with the Laboratory of Plant Pathology in 1933. In these studies, it was demonstrated that brown-heart of turnips was due to a deficiency of boron and could be readily controlled by the application of borax to the soil at the rate of fifteen pounds per acre in the drill or thirty pounds per acre broadcast. Further investigations in 1934, 1935 and 1936 demonstrated that corky core of apples could be controlled by applications of boron, whereas bitter pit was not attributable to a boron deficiency.

Dates, Rates and Methods of Application of Borax to the Turnip Crop

Preliminary Trials

The 1939 investigations were in response to an urgent request in early August from a local grower to investigate an outbreak of brown-heart in a 2¼-acre field of early turnips, planted on May 20. These turnips were three to four inches in diameter and although fertilized with a borated fertilizer, were very severely affected with brown-heart, it being difficult to find a sound root in the entire field. Efforts were concentrated upon trying to prevent a similar outbreak in five acres of late turnips, planted June 12-17 on the same farm. These turnips were just beginning to bottom up and hence were not large enough to show any symptoms of brown-heart.

Since no information was available at the time, whether or not late applications of borax would be effective, an experiment was laid out, comparing borax applied in the dry form scattered along the rows at the rates of 15, 20 and 30 pounds per acre and in solution poured along the rows at the rates of 20 and 40 pounds per acre. All treatments were remarkably effective in the control of brown heart, giving 100 per cent control with the exception of the fifteen pounds dry borax application. In this plot, a single turnip with a very mild type of brown heart was found. Compared with this, the adjoining checks gave readings of 100, 95, 85, 90 and 75 per cent brown-heart, respectively.

To test the effectiveness of borax applied in the form of a spray, a three-acre field was divided into three plots and sprayed with an orchard sprayer at 250 pounds pressure, the rates being 20 and 40 pounds of borax per acre, respectively, with a third plot serving as a check. While 76 per cent of the roots in the check plot were affected with brown-heart, the 20-pound borax spray showed only 16 per cent while the 40-pound spray gave complete control of brown-heart.

Main Trials

During the period 1940-1945 inclusive, more comprehensive experiments were conducted, using replicated plots and comparing various rates, dates and methods of application. Dates of application of borax have varied somewhat with the season. They have included an application prior to planting, and also some four or five applications, subsequent to planting and covering the period to late August or early September. For example, in 1941 the turnips were seeded on June 20 and the dates of application of borax were June 19, July 11, August 5, August 15 and August 29.

Methods of application included the dry method in which the dry borax was scattered along the row and lightly mixed with the soil; the wet method in which the borax was dissolved in water and poured along the row and a spray method by means of a hand-power barrel sprayer.

In Table 30 the data are assembled on the basis of the number of days elapsing between the date of seeding and the date of borax application. These results indicate that the date of application is the most important factor. The

TABLE 30.—EFFECT OF DATE OF APPLICATION OF BORAX UPON INCIDENCE OF BROWN-HEART IN TURNIPS—1940, 1941, 1943

Treatment per Acre	Time of Application	Number of Years' Results	Percentage of Brown-heart			
			Slight	Medium	Severe to Very Severe	Total
			%	%	%	%
15 pounds borax, dry	* − 1 to 3	3	1·9	0·8	0·4	3·1
	**+18 to 22	3	3·7	1·1	0·0	4·8
	+33 to 46	2	3·1	0·5	0·0	3·6
	+53 to 56	3	6·0	2·6	2·3	0·0
	+67 to 70	3	18·0	9·2	6·7	33·9
15 pounds borax in solution poured along row.	+55	1	5·8	0·0	0·0	5·8
15 pounds borax in solution poured along row.	+68	1	29·1	6·8	1·9	37·8
20 pounds borax as spray	+53 to 56	3	3·5	0·3	0·0	3·8
20 pounds borax as spray	+67 to 68	2	18·6	12·2	17·1	47·9
40 pounds borax as spray	+53 to 56	3	6·7	0·7	0·0	7·4
40 pounds borax as spray	+60 to 68	2	18·2	7·4	5·9	31·5
Check—no borax	.....	3	18·5	14·7	29·3	62·5

* The borax was applied to soil from one to three days before planting of seed, depending upon the year.

** The borax was applied to soil from eighteen to twenty-two days after the date of seeding, depending upon the year.

conclusions are that all three methods of application, including dry, wet and spray systems applied over a considerable range of time will control brown-heart satisfactorily, provided the roots have not bottomed-up to any extent and preferably before they have exceeded two inches in diameter. On a day basis, applications of borax later than 60 days after the date of planting will probably prove ineffective in the control of brown-heart.

TABLE 31.—SPRAY APPLICATIONS OF BORAX BY TRACTION-DRIVEN SPRAYER

Spray Treatment per Acre	Number Roots Examined	Percentage of Brown-heart					
		Trace	Slight	Medium	Severe	Very Severe	Total
		%	%	%	%	%	%
1944							
20 pounds August 25 and 20 pounds September 9	827	4·2	2·2	0·2	0·0	0·0	6·6
40 pounds August 25 and 40 pounds September 9	512	0·8	0·6	0·0	0·0	0·0	1·4
Check—no borax	290	7·3	15·5	14·5	10·3	6·9	54·5
1945							
20 pounds borax—September 4	547	4·9	4·2	0·2	0·3	0·0	9·6
40 pounds borax—September 4	424	5·9	5·3	1·9	0·2	0·0	13·3
Check—no borax	647	6·2	10·8	11·8	11·6	6·1	46·5

NOTE.—Date of Seeding—*1944*—July 4; *1945*—July 13.

Large-scale operations in 1944 and 1945 with a four-row traction-driven potato sprayer have substantiated the results of the hand-spray experiments and have demonstrated that outbreaks of brown-heart can be effectively and economically controlled by power spray equipment. No sticker nor spreader was added, the borax simply being dissolved in water. The data are contained in Table 31. In all tables, the amount of brown-heart in turnips classified as "Trace" is so small as to be unnoticeable by the average housewife.

RESIDUAL AND TOXICITY STUDIES WITH BORAX

Borax is toxic to most plants except in very low concentrations. The amount applied per acre must be small and evenly distributed. Moreover, certain crops such as cucumbers, beans and strawberries are very sensitive to boron, whereas beets, cauliflower and turnips are tolerant and are not injured by relatively heavy applications. The great majority of crops fall in classes intermediate between the two extremes. Even with the so-called tolerant crops however, applications in the drill of more than twenty pounds per acre may cause injury.

Because of these facts, it has been feared, both by growers and investigators that the application of borax to the turnip crop might result in such an accumulation of boron in the soil that sensitive crops following turnips in the rotation would be injured.

BEAN EXPERIMENTS

In order to determine the rapidity with which borax loses its toxicity after being applied to the soil, an experiment was conducted over the four-year period 1940-1943 inclusive, utilizing the bean, a boron-sensitive plant, and two rates of application of borax, 30 and 60 pounds per acre broadcast several days before the first planting of beans. All plots were in duplicate. Equal areas were used as checks. Successive plantings throughout the summer months showed that beans planted five days after the borax was applied were severely injured. As the interval between the date of application and the time of planting was increased,

a gradual lessening in toxicity occurred, until at ninety-two days there was little if any evidence of injury. Neither the 30- nor the 60-pound rate had any effect upon germination, but there was marked injury to the foliage accompanied by dwarfing of the plants. In the earlier plantings, dwarfing was always more severe with the 60-pound treatment and continued over a longer period. Yields of both tops and beans were reduced by both treatments.

There was also a noticeable tendency for all plants to outgrow the boron injury as the season advanced. Even in the most severely injured plots, the uppermost leaves formed in late summer showed little to no injury, depending upon the season.

As a further check upon the loss of the toxicity of the borax application, soil was collected from the 60-pound borax plots in the fall of 1941 before freeze-up. Beans planted in this soil in the greenhouse in January showed no evidence whatsoever of boron injury.

EFFECT UPON SUCCEEDING CROPS

In order to study the effect of borax on succeeding crops, one-half the area utilized in the above experiment in 1940 was seeded to oats and clover and the other half planted to turnips in 1941. There was no effect, injurious or otherwise, from the borax applied in the preceding year. In fact, at no time during the season was it possible to distinguish the treated from the untreated plots.

Utilizing land previously devoted to a borax experiment on potatoes the residual effect of borax was studied in another experiment in each of two years where oats, clover and turnips were planted on plots receiving 10, 20, 30, 60 and 240 pounds of borax per acre the preceding year. Regardless of the previous rate of application, there was no visible effect of the borax on the succeeding crop of oats and clover. Even the 240-pound borax application, which resulted in very serious injury to the potato crop, produced a normal oat crop in the succeeding year. This fact is borne out by the accompanying photographic evidence. (See Figure 17.)

There was however, sufficient residual effect from all treatments, including the 10- and 20-pound rates to effect a considerable degree of control of brown-

Figure 17—Oats (1942) following potato crop receiving borax. Left—20 pounds borax per acre to potatoes—1941. Right—240 pounds borax per acre to potatoes—1941.

heart in the turnip crop the following year. Only 66 per cent of the turnips from the untreated plots were free from brown-heart, whereas from 90 to 99 per cent of the turnips from the various borax treatments were clean.

FALL APPLICATIONS OF BORAX

Fall applications of borax at the rates of 30 and 100 pounds per acre made on November 21, 1942, exercised a high degree of brown-heart control on turnips planted in 1943. Plots receiving 30 pounds of borax per acre were 94·6 per cent clean as compared with 94·7 per cent for the 100-pound treatment and 69·9 and 61·7 per cent, respectively, for the two series of untreated plots.

EXCESS BORAX FOR POTATOES

The experience of potato growers during the first World War when considerable injury was encountered as a result of applying a form of potash containing considerable boron, is probably responsible for the current belief that the potato is extremely sensitive to boron injury. In fact, so strong is this belief that fear has sometimes been expressed regarding the advisability of planting potatoes on land which has grown a borated crop of turnips the preceding year.

In order to obtain some definite evidence on this point, preliminary investigations were conducted in 1938 and 1939. The results were of such a character that a comprehensive experiment was laid out in 1940 and repeated in 1941, 1942 and 1943. The rates of borax application were 10, 20, 30, 60 and 240 pounds per acre and all treatments were replicated four times. In 1940 and 1941, the borax was applied by hand along the bottom of a shallow drill and lightly mixed with soil with a hoe. Potato sets were planted two to three days later and thus came into close contact with the borax.

In 1942 and again in 1943, the method of application of previous years was changed and the borax and fertilizer was placed in two bands, approximately two inches on each side of the seed pieces. This duplicates the manner of application of the modern potato-planter. Two furrows, two inches deep and four inches apart, were opened up with a hand plough; the borax and fertilizer were applied by hand in these furrows and then a third furrow was opened up midway between the two original furrows and the potato sets dropped in it on the same day. This method results in a very uniform and accurate application of both fertilizer and borax and possesses the additional advantage that the seed pieces do not come closely in contact with the borax. Yield records and starch percentages are presented in Table 32.

Results were very different following this method of application, both as regards injury to top growth and reduction in yield resulting from the higher borax treatments. In 1941, the reduction in vigour of top in midsummer was

TABLE 32.—BORAX TRIALS WITH POTATOES—1940-1943

Treatment	Number Replications	Relative Total Yield				Starch Content		
		1940	1941	1942	1943	1941	1942	1943
						%	%	%
Check—no treatment	4	100	100	100	100	16·3	13·6	16·6
10 lb. borax per acre	4	103	96	101	107	15·5	13·0	16·6
20 lb. borax per acre	4	98	92	101	107	16·2	13·8	16·5
30 lb. borax per acre	4	91	85	98	99	15·3	13·3	16·4
60 lb. borax per acre	4	83	81	95	104	15·4	12·6	16·2
240 lb. borax per acre	4	16	48	82	67	15·2	14·5	15·4

NOTE.—Plots were 1/300 acre in area in 1940 and 1/200 acre other years.

classified as slight for the 10-pound borax treatment, slight to considerable for the 20- and 30-pound treatments depending upon the plot, severe for the 60-pound treatment and very severe for the 240-pound treatment. For example, on July 14 of that year the plants in the check plot had a spread of 14 to 16 inches. On the same date there was evidence of extreme chlorosis and injury in the 240-pound plots, many of the plants were just emerging and only approximately one-third of the plants had a spread of more than six inches.

The 1942 results were directly in contrast with these. At no time of the year was there any appreciable reduction in top vigour with any treatment. In the abnormally wet season of 1943, top vigour was slightly reduced by all treatments but this was not reflected in the yield since the only treatment to give a definite decrease in yield was the 240-pound borax application.

As with all borax experiments, results vary with the season. When the borax was applied in the drill, yields were not affected by a 10-pound-per-acre borax application, and only slightly reduced by the 20-pound treatment. Yields were noticeably lowered by the 30- and 60-pound treatments and very drastically reduced by the 240-pound application.

When borax was applied in the band method and did not come directly in contact with the seed pieces, yields were not reduced by applications as high as 30 pounds per acre and only slightly reduced by the 60-pound treatment and then only in one of the two years of the test.

Starch readings are available on the potatoes from the various treatments for the years 1941, 1942 and 1943. The results indicate that borax applications have little if any effect upon potato quality as measured by the starch content of the tubers.

General Conclusions

When borax is applied in the band method, no injurious effects should be encountered from applications of borax as high as 20 and probably 30 pounds per acre. In fact, it is conceivable that actual increases in yield may result from light borax applications on certain soil types.

The results indicate the advisability of extending these borax trials to typical potato soils in various parts of the province.

Fertilizer Treatment Affects Potato Quality

L. C. Young H. T. Davies and R. G. White

Over a period of years, potato growers have been applying increasing amounts of commercial fertilizer to the potato crop until, at the present time, applications of 2,500 pounds and more per acre of a 4-8-10 fertilizer are common. Farmers in general, feel that these heavy applications are essential to maximum production. On the other hand, there is little experimental evidence to indicate the necessity of such heavy applications or to demonstrate that the most economical analysis is being used. Moreover, the effect of fertilizer treatment upon cooking quality has been overlooked almost entirely.

During recent years, the enviable reputation for high quality of New Brunswick table-stock potatoes upon the markets of Quebec and Ontario is gradually being lost. Among the several factors contributing to this trend, possibly one of the most important is fertilizer treatment. Experiments have been conducted to determine the effect upon quality of applying a 4-8-10 fertilizer at various rates as well as varying rates of potash application.

It is now rather generally accepted that specific gravity is correlated with cooking quality. The higher the specific gravity, the greater is the starch content of the tuber and the more mealy the potato when cooked. In the experiments under review, the specific gravity was determined by the flotation

method in brine solutions of known concentration in the first five years of the experiment. In the sixth year, a specially constructed hydrometer was used. With the former method, twenty tubers from each replicate, or a total of one hundred tubers for each treatment, were used. With the latter method, a ten-pound sample from each replicate was employed.

A conversion table was then used to convert the specific gravity readings to starch percentages and the data are presented as such.

RATES OF APPLICATION

An experiment involving a 4-8-10 fertilizer applied at the rates of 1,000, 1,500, 2,000 and 3,000 pounds per acre has been under way for a period of six years. All treatments were replicated five times and data, relative to starch content, are presented in Table 33.

The results clearly indicate that as the amount of fertilizer is increased, the starch content is decreased and the cooking quality consequently lowered.

TABLE 33.—EFFECT OF RATES OF APPLICATION OF A 4-8-10 FERTILIZER UPON POTATO QUALITY—SIX-YEAR AVERAGE

Rate of Application of a 4-8-10 Fertilizer	*Starch Content
	%
Check—no treatment	**18·11
1000 pounds per acre	16·70
1500 pounds per acre	16·10
2000 pounds per acre	15·70
3000 pounds per acre	14·79

* Starch content determined by conversion from specific gravity readings.
** Difference required for significance at the one per cent level—0·37 per cent starch.
Location of Experiment—Four years at Fredericton, one year in Sunbury county and one year in Carleton county.

RATES OF APPLYING POTASH

Various formulae of potato fertilizers with the potassium ranging from 0 to 20 per cent, have been tested in an experiment which has been in operation for a period of six years. The formulae used are as follows: 4-8-0, 4-8-5, 4-8-10, 4-8-15, 4-8-20 and 8-8-20. All treatments were replicated five times and the rate of application was 1,500 pounds per acre. Yield records and starch percentages are given in Table 34.

TABLE 34.—EFFECT OF RATE OF APPLICATION OF POTASH FERTILIZER ON THE STARCH CONTENT AND YIELD OF POTATOES

Formula	Pounds of K_2O Applied	Yield of Marketable Tubers per Acre*	Starch Content**
		bushels	per cent
Check—no treatment	0	244·1	18·3
4-8-0	0	276·3	17·7
4-8-5	100	301·6	16·6
4-8-10	200	291·7	15·9
4-8-15	300	313·6	15·3
4-8-20	400	295·9	14·9
8-8-20	400	318·1	14·7

* Five-year average—Difference required for significance at the five per cent level: 34·0 bushels.
** Six-year average—Difference required for significance at the five per cent level: 0·37 per cent starch at the one per cent level: 0·48 per cent starch.
Location of Experiment—Four years at Fredericton, one year in Sunbury county and one year in Carleton county.

The results indicate that with each successive increase of potassium in the fertilizer there was a significant decrease in the percentage of starch in the tubers. As shown in the table, on the basis of a six-year average, increasing the potassium equivalent from 0 to 400 pounds of K_2O as furnished by a 4-8-0 and 4-8-20 fertilizer respectively, resulted in a decrease in starch content from 17·7 to 14·9 per cent, or nearly 3 per cent. Moreover, there was no significant increase in yield, resulting from the increased potash application.

The potassium used in these tests was in the form of muriate of potash, the source commonly available to potato growers. No attempt is here made to theorize as to the probable explanation for these results. For the purposes of this experiment, it is immaterial whether the results are due to excess potassium itself, excess chloride, unfavourable nitrogen potassium balance, magnesium deficiency or some other factor. The facts are that the starch content of tubers is lowered by excess applications of a 4-8-10 fertilizer or by increasing rates of application of potassium. The need of more extensive research into the whole problem of potato fertilization is indicated.

Potato Breeding

L. C. Young and H. T. Davies

The potato-breeding program at the Fredericton Station was initiated on a modest scale in 1933. It is in the nature of a co-operative project between the Experimental Farms and Science Services of the Dominion Department of Agriculture, with the Experimental Station assuming responsibility for the horticultural phases of the program, including the making of crosses, production and multiplication of seedlings and the assessing of the commercial value of all productions. The Laboratory of Plant Pathology is responsible for the determination of the disease resistance and the Laboratory of Entomology for studies on aphid resistance of various seedlings productions.

The importance of the project is emphasized by the fact that the potato-breeding activities of the Dominion Department of Agriculture for the whole of Canada are centralized at this Station. At the outset of the program, effort was concentrated on breeding for resistance to two diseases only, namely mild mosaic and late blight. Since that time, the program has been broadened from time to time in an effort to solve problems of outstanding importance, and in response to requests from various sections of Canada for new varieties of potatoes possessing certain definite characteristics.

In 1936, breeding for scab resistance was added to the program. Common scab, in itself, is not considered to be of major importance in many of the better potato-growing districts. However, when one considers that the susceptibility of existent varieties to common scab is responsible for the inability of potato growers to adopt good farming practices essential to the production of optimum yields of crops such as clover, the importance of the problem becomes self evident.

Since 1937, leaf roll has assumed epidemic proportions in Eastern Canada, changing it from a relatively unimportant disease in 1933 to easily the most important and most serious virus disease in recent years. The seriousness of this problem has rendered it imperative that breeding for resistance to leaf roll be included in the program.

The subject of resistance to aphids as a means of reducing not only the injury resulting from feeding, but also of controlling the spread of virus diseases, has also received some attention during recent years.

In addition to these characters of a more or less specific nature, any breeding program must also concentrate effort on desirable horticultural characters

which are often too frequently taken for granted. These include such factors as type of top-growth, season of maturity, yielding ability, tuber type and cooking quality.

METHODS

In the period under review in all aspects of the breeding program, from the actual production of the seedlings to their testing for disease and insect resistance, every possible effort has been made to adopt and to devise methods combining efficiency and practicability and in keeping with the most modern ideas in potato-breeding.

In general, there has been a substitution of greenhouse methods for the more laborious and more inefficient field practices. Pollination, at one time conducted in the field, is practised entirely in the greenhouse at the present time. Excellent results are secured during the months of April and May by planting either directly into the bench or in five-inch pots with the intervening spaces filled with sphagnum moss, by maintaining a relatively high humidity combined with a temperature preferably not above seventy degrees Fahrenheit and by the use of supplemental light as furnished by 100-watt Mazda bulbs, which are switched off every night at ten o'clock.

The method of handling seedlings has undergone drastic changes. In the early days of the program, the true seed was planted in the greenhouse in March and the resulting seedlings transplanted into the field in early June. At the present time, seed is planted in July and the seedlings grown to maturity in the greenhouse and harvested in December. The tubers are then planted in the field the following spring.

The difficulty of maintaining stocks of seedling potatoes free of virus diseases at the Fredericton Station, necessitated the establishment of an Isolation Station at Alma, Albert county, where all stocks are now being propagated.

The station is located in an area widely separated from other potatoes and in a coastal region where aphids are not usually abundant.

EXTENT OF PROJECT

In any breeding program, it is difficult to record progress in a concrete form prior to the stage at which productions are ready for introduction. A consideration of the number of seedlings produced in the various phases of the program gives some idea of the extent of the project.

The data presented in Table 35 indicate that a total of 144,953 seedlings have been produced to date. Of these, 83,730 seedlings have been developed and tested in the late-blight phase of the program in an effort to originate a new blight-resistant variety of potato.

As a further indication of the extent of the project at the present time, the following brief outline for the year 1947 is presented. In the late-blight phase

TABLE 35.—NUMBER OF SEEDLINGS PRODUCED 1934-1947 INCLUSIVE

Objective	Number of Seedlings
Resistance to mild mosaic	33,640
Resistance to late blight	83,730
Resistance to common scab	20,525
Combined resistance to late blight and common scab	1,260
Resistance to leafroll	974
Resistance to aphids	2,593
Miscellaneous	2,231
Total	144,953

Figure 18—Potato seedling multiplication plots. One suitable new variety requires the testing of thousands of seedlings.

Figure 19—Potato seedlings in greenhouse, Fredericton, N.B.

of the program, a total of 204 blight-resistant seedlings were grown in lots varying from 50 to 489 hills each. These represent the accumulated selections to date. Some 111 of these were discarded as having no further promise and 93 were selected for further observation and several for extensive propagation. An additional 1,008 seedlings were given their second field trial. Of these, 880 were discarded and 128 saved for future trial. A total of 4,799 seedlings planted from small tubers grown in the greenhouse the preceding year were given their first test in the field. Some 4,378 were discarded and 421 selected for additional observation. The number of new blight seedlings grown in the greenhouse from true seed totalled 9,366.

In the scab phase of the program, 142 seedlings, representing the accumulated selections to date were grown in lots varying from 50 to 250 hills each. Seventy-seven were discarded and 65 selected for future trial. A total of 1,844 seedlings, planted from small greenhouse-grown tubers were given their first field trial and 190 were saved for further observation. The number of new scab seedlings grown in the greenhouse from true seed totalled 1,684. An additional 667 seedlings were produced with the objective of combining resistance to common scab with resistance to late blight.

Work in the mosaic resistance, leaf roll resistance and aphid resistance phases of the program was conducted on a less extensive scale. Some 2,156 aphid seedlings, 472 leaf roll and 842 seedlings produced for miscellaneous purposes were given their first field trial.

Summarizing, a total of 14,553 new seedlings were grown from true seed in the greenhouses. Some 10,113 seedlings were given their first field trial and 850 were selected for additional trial. A total of 204 blight seedlings, 142 scab seedlings and 98 mosaic seedlings were given an extensive field trial. An additional 1,008 blight seedlings were given their second field trial. Twenty-one blight-resistant seedlings were included in replicated yield trials conducted on privately-owned farms in Charlo and Salmonhurst and 28 blight-resistant seedlings, 12 scab-resistant seedlings and 16 named varieties were tested in replicated yield trials at the Macdonald's Corner Horticultural Substation. Some of the more promising seedlings were tested by co-operating institutions in every province throughout Canada. In addition, there were the extensive disease-resistance trials and aphid-resistance tests as conducted by the Laboratories of Plant Pathology and Entomology respectively.

PROGRESS TO DATE

It is in the late-blight section of the program, in which more than 83,000 seedlings have been produced, that the most definite progress has been made. In most of this work, the wild species, *Solanum demissum* Lindl., has been used in all original crosses. This wild species is immune to late-blight, but unfortunately possesses many undesirable horticultural characters including long stolons and low yielding ability. The tubers are about the size of a hazel nut and are usually borne on long stolons which in some instances may reach a length of several feet. In order to weed out these undesirable characters, this wild species has to be crossed and then backcrossed for several generations with cultivated varieties. Thus many of the blight seedlings have a very complicated pedigree containing as high as seven distinct crosses in a single pedigree.

A considerable number of these seedlings are extremely promising. In this connection, it should be stressed that these seedlings are very highly resistant to late-blight. In fact, even when unsprayed, they have failed to develop any blight whatsoever, as tested under local conditions. The possibility of the existence of physiologic forms of the late-blight organism renders the widespread testing of these seedlings, as is being conducted at the present time, very important. These seedlings also appear satisfactory from the standpoint of appearance, yielding ability and quality. It is believed that at least three

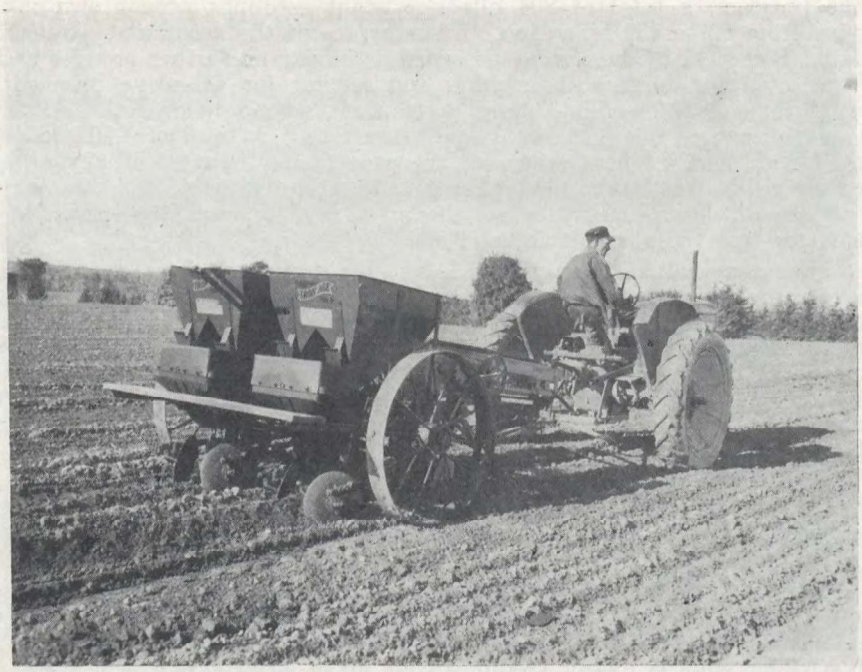


Figure 20—Two-row potato planter with fertilizer attachment for plot experiments, Fredericton, N.B.

Figure 21—Two-row potato digger.

or four of these varieties are particularly adapted to the coastal regions of the Maritime Provinces, where potato fields are small, where little or no spraying is attempted and where late-blight frequently kills the tops in midsummer, resulting in almost a total crop failure. As a result of the extensive testing now under way, certain seedlings may also prove quite satisfactory in the main potato growing sections.

RESISTANCE TO COMMON SCAB

Crosses in this group have been confined to a few European varieties including Hindenburg, Arnica and Richter's Jubel possessing a high degree of resistance to common scab and the common commercial varieties. Work in this line has been somewhat limited, only 20,525 seedlings having been produced, owing to the concentration of effort on the late-blight program. In breeding for scab resistance, it is not difficult to produce seedlings that are highly resistant to scab but almost invariably these seedlings are very late in season. On the other hand, it seems to be extremely difficult to combine earliness with scab resistance.

However, of the 65 seedlings under close observation at the present time, several are no later in season than Green Mountain and may have definite promise.

An attempt is also being made, on a modest scale, to combine late-blight resistance and scab resistance in the same individual.

RESISTANCE TO LEAF ROLL

Leaf roll is the most serious virus disease affecting potatoes in Eastern Canada today. Breeding for resistance to this disease is complicated by the fact that there is no known variety or species of potato possessing a high degree of resistance to leaf roll available anywhere in the world, that can be used as a starting point in a breeding program. Only a few crosses with the specific objective of obtaining leaf roll resistance have been made. However, considerable of the material in other phases of the program has been subjected to tests for their resistance to leaf roll.

In these tests, a number of seedlings with apparently considerable resistance to leaf roll have been spotted as indicated by the fact that they do not pick up the disease in the field nearly so readily as do the standard varieties. Although all these seedlings will eventually contract leaf roll after repeated exposure, several of them do appear to have a type of field resistance. One seedling in particular in this group gave a satisfactory performance across Canada is 1947.

RESISTANCE TO APHIDS

Aphids are of importance to the potato grower, first, because of the injury they cause to the plants as a result of their feeding habits, and second, because they are the agents that transmit the virus diseases. It is known that varieties of potatoes differ in their resistance to aphids. This fact suggests the possibility of controlling virus diseases by producing a variety resistant to aphids.

This phase of the program is of recent origin, and a total of only 2,593 seedlings have been produced with this objective in view.

ORGANIZED TESTING THROUGHOUT CANADA

Commencing in 1945, a comprehensive and widespread testing of seedlings throughout all of Canada was initiated. Co-operating in these trials are Experimental Stations, located in every province as well as several Agricultural Colleges. This outside testing is under the supervision of N. M. Parks, Division of Horticulture, Central Experimental Farm, Ottawa.

ILLUSTRATION STATIONS

Black River Bridge—Northumberland County

OPERATOR—J. WALTER CAMERON

The soil at this station is a heavy clay on which it is difficult to grow potatoes or root crops successfully. In developing the farm layout, therefore, the best drained areas were selected for a four-year rotation of roots, grain, clover and timothy while the remaining fields were developed in a six-year rotation of grain, hay and pasture. A one-acre block, near the farm buildings, has been tile drained with excellent results and a young orchard has been established on this area. Crops respond well to liberal manure and fertilizer applications and lime has been found to be essential to the production of a satisfactory clover crop. In both rotations there has also been noticeable improvement in the timothy crop where lime has been applied. In general, tests reveal that on this heavy soil drainage is very important, either surface or if feasible tile drainage. This should be accompanied by liberal applications of limestone along with the utilization of all available manure supplies supplemented by chemical fertilizers.

Crockett—Madawaska County

OPERATOR—CLAUDE LEVASSEUR

This station has been in operation only two years. A four-year rotation of potatoes (Foundation Seed), grain, clover and timothy has been established on small fields near the farm buildings. The bulk of the farm falls into a six-year rotation of two years in grain, one year in clover and three years timothy. In addition there are 20 acres in permanent pasture and a 45-acre river island which produces a valuable hay crop. Fertility studies have been initiated both with potatoes and with pasture. To date, excellent results have been obtained from the permanent fertilized pasture. Demonstrational work has also been done with 2,4-D as a control of wild mustard in grain. This weed is very prevalent at this station in common with other farms in the area. Tests reveal that 2,4-D gives excellent control at very little cost (See section on Weed control). The main soil type is classified as Riverbank sandy loam, a type very common throughout the province. It is normally well drained, early and easy to work. However, because of its light sandy nature it is important that the organic-matter content be maintained. This has been done at the above station by frequent manure applications and ploughing down good sods. On farms where the same type of soil has been depleted of organic matter, crop yields have fallen off sharply despite heavy fertilizer applications.

Currieburg—York County

OPERATOR—HOWARD SANDWITH

This station is a 100-acre farm on which 33 acres are cropped, 7 acres are in permanent pasture and the remaining 60 acres form a valuable wood-lot. The cultivated area is level and uniform throughout and is used in a five-year rotation of potatoes, grain, clover and two years timothy. The soil is a medium loam ideal for potato production. During the war years turnip seed was grown successfully but this has been dropped in favour of an increased potato acreage. Fertility studies reveal an outstanding response to manure for all crops in the

rotation. Liberal limestone applications have in many instances resulted in doubling the hay yields, while supplemental fertilizer applications have also given profitable response. In connection with turnip production it has been found that borax applications have been found necessary in order to prevent brown-heart. A fertilized pasture has been in continuous production for the past seventeen years. During the past several seasons, however, the response to fertilizer treatments has decreased and it is expected that ploughing and reseeding will be found necessary in order to maintain production at a high level. A 60-tree orchard was started in 1941 in a root and framework stock test, results of which should provide useful information as climatic conditions in the area vary considerably from the river district.

East Centreville—Carleton County

OPERATOR—ERNEST M. EMERY

Located in the potato producing area of the province, this station, started in 1942, is devoted largely to a study of potato production problems. The farm consists of 127 acres of which 76 are under cultivation and an additional 15 are in permanent pasture. The soil is classified as Caribou loam. At the present time there are a total of 174 plots in two separate projects designed to obtain data on the effect of various fertilizer, manure and lime treatments on the potato crop as well as on the grain and clover crops. A recent development demonstrates erosion control methods on a hillside field. Potatoes are planted on the contour with a diversion ditch and sod water-way established to control run-off water. More detailed reference is made to these projects elsewhere in the text. The farm is organized in five rotations with land suitable for growing potatoes divided into four separate three-year rotations of potatoes,

Figure 22—Potato digger and picker, Keswick, N.B.

Figure 23—Picking potatoes near Centreville, N.B.

grain and clover while the remaining land, which is hilly and rough, is divided into three fields and a rotation of two years grain and four years hay is followed. Pasture studies round out the fertility program. In addition, this station has also become a centre for Advanced Registry Swine.

Guercheville—Restigouche County

OPERATOR—MARTIAL DUBÉ

This station was started in 1945 to replace one which had closed in nearby St. Quentin and considerable progress has been made to date. The farm consists of 196 acres of which 118 are cropped and 23 are in permanent pasture. The soil is classified as a Caribou loam, the same type as at the Centreville and Siegas stations. This soil, however, has been under cultivation for a much shorter period. A four-year rotation of potatoes and roots, grain, clover and timothy has been established on three 1-acre fields which are being used for fertility studies. Excellent yields of all crops have been obtained during the past two years. The remaining portion of the cultivated area is in a grain-hay rotation. Permanent pasture has responded well to fertilization and yields have been among the highest of any station in the province. The pasture season, however, is comparatively short. It is planned to expand fertility and erosion control studies considerably at this station.

Hampstead—Queens County

OPERATOR—JOHN B. ELDER

This station, in operation since 1939, is located on a 100-acre farm with 43 acres under crop and 23 acres in permanent pasture. The soil on the farm is very stony in keeping with other farms of the district which are also hilly

and in general have a low fertility level. Tests show a favourable response to fertilizers but the outstanding result of tests is the increased yield from manure, especially of hay crops. In some cases hay yields have been doubled where liberal manure applications have been made as compared with fertilizers used alone. A feature at this station is an experiment dealing with pasture seeding and management. Sections of the permanent pasture were ploughed or harrowed in 1941 and were limed, manured and reseeded. This has been followed by yearly applications of fertilizer and results show the yield of grass from these areas is doubled as compared with areas which received only surface applications of fertilizer and seven times the yield of areas which received no treatment. Further details of these tests are to be found in the text. Fertility studies are carried on in conjunction with a four-year rotation of hoed crops, oats, clover and timothy. This rotation takes up 12 acres, the remainder is in a grain-hay rotation.

Lower Derby—Northumberland County

OPERATOR—W. R. TAYLOR

This station is the oldest in the province having been in continuous operation since 1921. At present it consists of 130 acres with 34 cropped, 21 in improved pasture, 19 in native pasture and the remainder in wood-lot. There are two types of soil on the farm. Near the river it is a sandy loam and this area is worked in a four-year rotation of hoed crops, grain, clover and timothy. Farther back the soil has a heavier texture and poorer drainage. This section is worked in a six-year rotation of hoed crops, grain, clover, two years timothy and pasture. The native fertility of soil in this area is not high, nevertheless, through the judicious use of manure, lime and fertilizers this farm has been built up to a high fertility level. This is indicated by the excellent crop yields being obtained, especially alfalfa and clover. Fodder corn does very well on the sandy loam and mangels have also been grown very successfully. Both soil types show good response to lime and fertilizer treatments. In building up this farm, credit must be given to the fact that a large livestock population of cattle, sheep and hogs has always been maintained to utilize farm produce and provide a liberal manure supply.

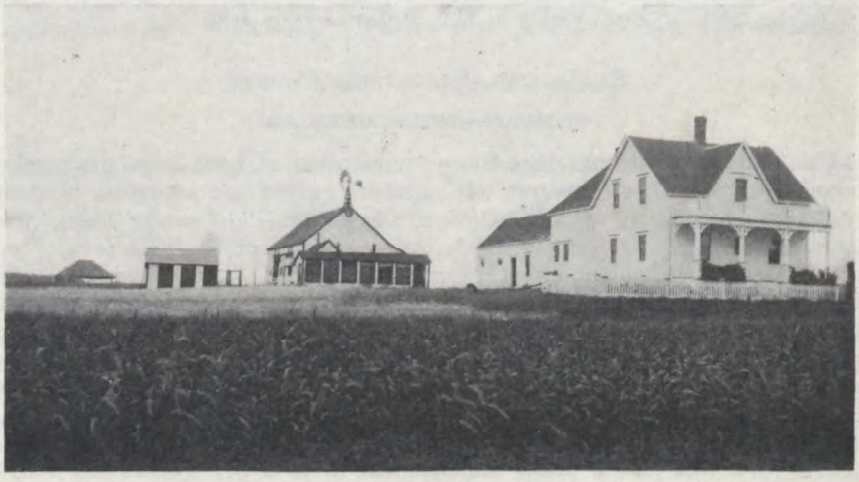


Figure 23(*a*)—Illustration Station at Mont Carmel, N.B., showing attractive layout of farm buildings.

Mont Carmel—Kent County

OPERATOR—CLORIS MELANSON

This farm is located on a uniform sandy loam soil with 46 acres under cultivation, 20 acres in pasture and the remainder in managed wood-lot. The soil is classified as Queens sandy loam. The main rotation is hoed crop, grain and clover on three fields near the farm buildings. The remainder is in a grain-hay rotation. As with other sandy soils, the necessity of farm manure is very marked at this station especially in maintaining clover and timothy yields. Liberal fertilizer applications to root crops and hay meadows has also given good response. Returns from permanent pasture fertilization have, however, been very small. Efforts to improve this pasture by ploughing, liming and reseeding are in progress. In 1945, the farm wood-lot was placed under management in co-operation with the Dominion Forest Service. The wood-lot is divided into ten compartments and one of these is cut over each year removing mature and undesirable trees. In this way more room is left for young trees to grow thus increasing the growth rate of the wood-lot. This work provides an excellent example of what can be done with a small farm wood-lot.

St. Charles—Kent County

OPERATOR—ANTOINE DAIGLE

The St. Charles farm contains 190 acres with 44 under crop and 10 in permanent pasture. A valuable asset, the farm wood-lot, was destroyed by fire in 1946. The soil at this station is a light sandy loam (Riverbank), low in fertility and organic matter. Light rainfall during the past few seasons has resulted in very poor crops causing a reduction in the number of livestock which in turn reduces the supply of badly needed manure. The soil has shown very favourable response to lime and fertilizer treatments and in years of ample rainfall good crops have been obtained. The inability of this soil to retain moisture, however, is the limiting factor in crop production. In view of the scarcity of manure an effort is being made to make greater use of green manures. Japanese millet and other crops are to be grown in the rotation and ploughed down. Pasture yields at this station have also been very low and for this reason tests are being made with more drought-resistant grasses. Further reference is made to crop yields at this station in the text.

St. Isidore—Gloucester County

OPERATOR—PETER ROBICHAUD

This station is laid out in a five-year rotation of hoed crop, grain, clover, two years timothy and pasture. In addition, eight acres are in permanent pasture. As at the St. Charles station, the soil is light sandy loam, low in organic matter. The extremely dry growing seasons of the past several years have resulted in very poor crops, especially hay and pasture which have also suffered from winter-killing. Fertility tests indicate the necessity of manure to maintain yields of all crops in the rotation. Lime is also necessary in order to produce clover. Supplemental fertilizer treatments have also given profitable returns especially with potatoes and turnips. It has been found that borax is essential in order to prevent brown-heart in turnips. Corn usually does well and has proved very valuable in supplementing fall pastures. The wood-lot on the station was placed under management in 1945 in co-operation with the Dominion Forest Service and is being cut on a basis similar to that at the Mont Carmel station.

Salisbury—Westmorland County

OPERATOR—TRUMAN LEWIS

Sixty-nine acres are cropped at this station in addition to six acres in permanent pasture. An additional acreage is also available for pasture on a rented basis. The farm is level and the soil quite uniform throughout, consequently the entire area has been divided into five fields of approximately equal size and a five-year rotation of one year grain and four years hay is followed. A small acreage of roots is also grown in the grain year. It has been found that borax is necessary at this station to produce turnips free from brown-heart. The soil at the station is a heavy clay which is difficult to work. It is classified as Salisbury and Petitcodiac clay loam. Drainage is extremely important and crop yields have been improved by both tile and open ditching. Considerable difficulty has been experienced in getting legumes established but some improvement has been noted on areas which have been drained followed by liberal applications of manure and lime. Response to permanent pasture fertilization at this station has been poor to date. In an effort to increase grass growth, parts of the permanent pasture have been ploughed and will be limed and reseeded. Similarly, in an effort to produce more abundant hay yields, a number of seed mixtures containing a variety of species are under test.

Siegas—Madawaska County

OPERATOR—ROMEO RUEST

A total of 90 acres are cropped at this station with 30 acres in permanent pasture and a 50-acre managed wood-lot. The main section of the farm falls into a five-year rotation of grain, potatoes, grain, clover and timothy. It has been customary in recent years to plant part of the grain acreage to potatoes. The soil on this section of the farm is a Caribou loam, ideal for potato production and tests have shown a good response from fertilizer treatments up to one ton per acre. Alfalfa and clover also do well. A light application of lime following the potato crop is beneficial in getting a good catch of these crops. On sections not used for potato production two or three tons of lime have been used with success. A hillside field too steep for regular cultivation has been developed as a permanent fertilized pasture with good results. A new experiment is designed to study the effect of peat as a source of organic matter. Poultry is a specialty at this station and a large flock of Barred Plymouth Rock hens is maintained.

Silver Falls—St. John County

OPERATOR—FRED SHILLINGTON

On this station 33 acres are under crop, mostly hay, and an additional 30 acres is in permanent pasture. A large herd is maintained at the station for the production of fluid milk which is sold in nearby Saint John. The main purpose in establishing this station was to acquaint the farmers in the coastal areas with grass and clover silage, as a means of storing part of this crop. Heavy fogs which prevail in the area during the summer months make it difficult to cure hay. A silo was constructed in 1940 and has been filled each year with grass and clover and green oats which makes an ideal succulent feed. Excellent results have also been obtained from pasture fertilization. Pastures seldom dry up in midsummer and there has been good response from heavy applications of complete fertilizer. Potato blight is severe in this area and this station is serving as a location to test blight-resistant seedlings being developed at the Fredericton Station. In 1947, several of these new seedlings were free from blight and produced well while the main crop of Green Mountains were a crop failure due to blight.

Cumberland Point—Queens County

OPERATOR—MRS. W. C. MCQUINN

Situated on the southeast shore of Grand Lake, this station was started in 1941 for the express purpose of establishing a cranberry bog. This location has the advantage of a longer frost-free period than most parts of the province. Vines were set out in 1942 and the bog is now coming into heavy production, 3,300 pounds being picked in 1947 from less than an acre. Further details of this study are included in the text under "Cranberries". In addition, a 70-tree orchard was set out in 1942 in a Fruit Tree Root and Framework Stock Test. To date these trees have made very promising growth. Tests are also in progress with hops, blueberries, raspberries and grapes.

Farm Business and Planning

FARM PLANNING

The object of a farm plan is to make the best use of all available land. Of the 30,000 farms in New Brunswick no two are alike, making it impossible to set forth a plan to suit all or even a large number of farms. However, there are certain principles which do apply in most cases and should be considered in developing the farm layout. The two accompanying diagrams, see Figures 23(*b*) and 23(*c*), show the original layout of the Illustration Station at Centreville, Carleton county, owned and operated by Ernest Emery, and also the new layout, incorporating the principles involved in making the best use of land available.

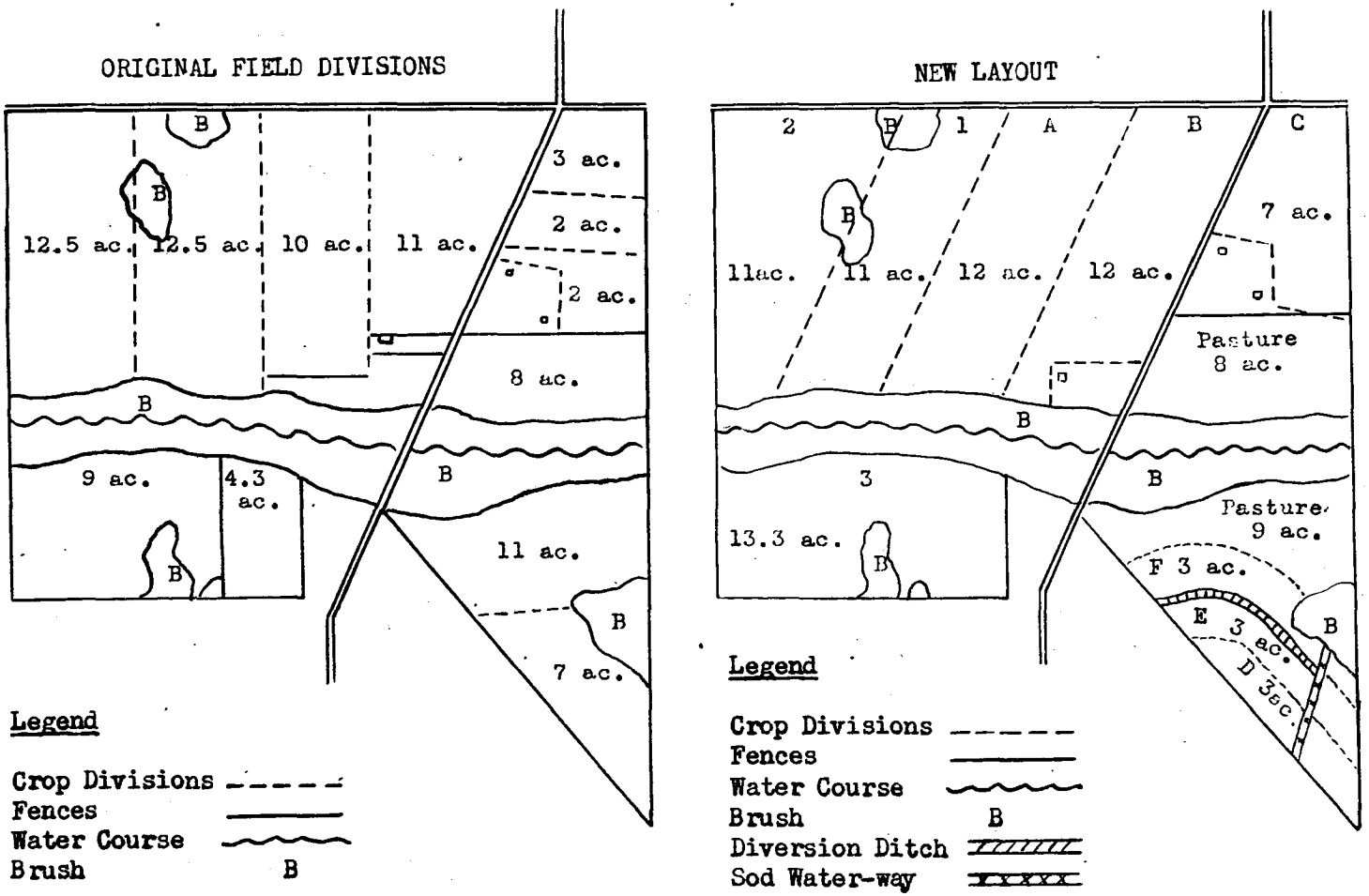
These diagrams illustrate several changes which have been made recently with a view to increasing operating efficiency and controlling water erosion. Fields A, B and C form the main rotation of potatoes, grain and clover. This land is comparatively level and ideal for potato production. The changes made in the shape of the fields from the original layout were designed to eliminate short rows as much as possible thereby increasing the efficiency of machinery in planting, spraying and digging.

Fields 1, 2 and 3 are rough and have many low wet spots. These fields are used for grain and hay production following a rotation of two years grain and four years hay.

Fields D, E and F are located on a hillside with an eight per cent slope. Much of the top soil has been lost from this field by previous cropping. In order to protect it from further damage, and at the same time maintain the desired potato acreage, a diversion ditch was constructed to break the slope and carry the run-off water away at a gentle grade. A good sod has been established in this ditch and sod has also been left on the natural waterway from an adjoining farm. Both empty into a wooded area as shown. A three-year rotation of potatoes, grain and clover is being established with potato rows being planted on the contour and parallel to the diversion ditch.

The remaining area of this field, as well as that adjoining it on the opposite side of the brook, is very steep and is being developed as permanent fertilized pasture.

To develop such a layout requires technical advice and assistance; however, for the average farm the actual cost and labour involved is small. For example, the work carried out at this station required two men with a tractor and grader for approximately one day. A diversion ditch seven hundred feet long was constructed in that time. The only additional time spent was in harrowing, fertilizing and sowing grass seed to establish a sod in the ditch.



Figures 23(*b*) and 23(*c*)—Illustration Station, East Centreville, N.B., showing original land divisions (left) and the new layout (right). Operator is E. M. Emery.

LAND UTILIZATION

A survey of New Brunswick Illustration Stations shows that only forty per cent (61·5 acres) of the total acreage is under cultivation while the remaining sixty per cent (95·5 acres) is in wood-lot, native pasture and farmstead. Because of this limited acreage it is necessary that each acre of the farm be brought into effective use, if the farm organization is to be run on a profitable basis. The development of a sound land-use policy at each Illustration Station is one of the primary objectives of station work and the following points have been stressed.

(1) Choice of a suitable rotation or rotations.

(2) Improving surface and tile drainage and erosion control.

(3) Utilizing all available manure supplies and supplementing them with fertilizers and lime.

(4) Locating permanent pastures on suitable sites.

(5) Selecting suitable crops and varieties.

(6) Where large acreages are in wood-lot, adopt a sound plan of management.

Failure to make best use of all available land results in the full load of operating costs, taxes and maintenance being borne by only part of the land and results in a reduction of the financial effectiveness of the farm and a higher cost of producing a unit of crop which in turn reacts to the disadvantage of the operator.

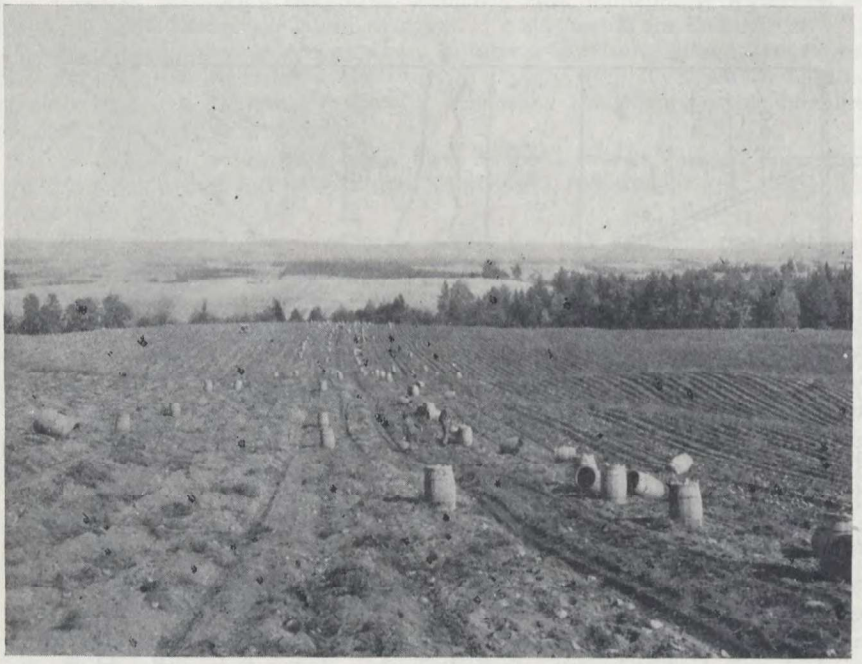


Figure 24—Planting potatoes on the contour instead of with the slope, as shown above, would help to prevent soil erosion.

FARM CAPITAL

Inventory records for twelve Illustration Stations which have been in operation for the past five years show that on the average sixty-five per cent of the capital investment is in land and buildings, twenty per cent is in livestock and fifteen per cent is in machinery and equipment. The average investments per acre of crop land amounts to $142.74 while the average gross receipts per acre of crop land is $46.59. The figures for individual stations are given in Table 36 and show a wide variation in capital distribution, investments per acre and receipts for the different units. The majority of stations depend on the sale of livestock and livestock products as their chief source of revenue and in such cases the objective is to increase the carrying capacity of the tillable acreage, while at the same time improving the quality of stock which are kept. In other words, a closer relationship between land investment and livestock investment provides a greater opportunity to maintain or increase income. Two stations, Currieburg and East Centreville, derive considerable income from seed potato production. This results in a higher percentage of capital being tied up in machinery and equipment. The sale of these cash crops has resulted in a greater money turnover at these stations. They are the only two which show gross receipts per acre above average while their investment per acre is below average. With the remaining stations, after taking into consideration such factors as location, soil, etc., there appears to be a more definite relationship between investment per acre and gross receipts per acre.

TABLE 36.—DISTRIBUTION OF CAPITAL, INVESTMENT PER ACRE AND GROSS RECEIPTS PER ACRE

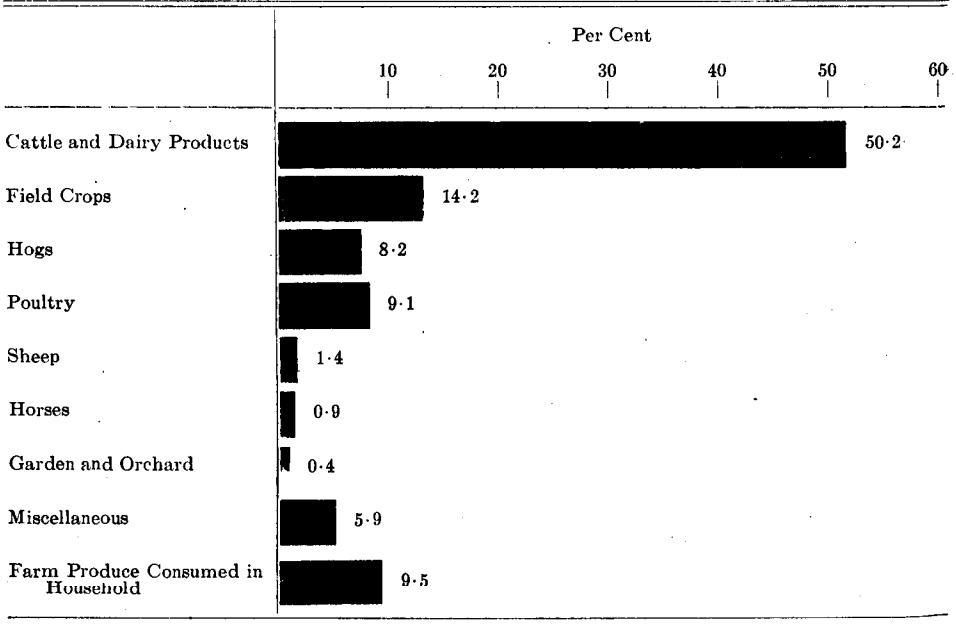
Average 1942-1946—New Brunswick Illustration Stations

Station	Land and Buildings	Livestock	Machinery and Equipment	Investment per Acre of Crop Land	Gross Receipts per Acre of Crop Land
	Percentage of Total Investment	Percentage of Total Investment	Percentage of Total Investment		
				$	$
Black River Bridge	62	23	15	92·86	18·42
Currieburg	56	20	24	138·38	53·27
East Centreville	56	20	24	108·57	48·87
Hampstead	63	25	12	85·40	34·25
Lower Derby	69	19	12	238·96	52·10
Mont Carmel	63	30	7	95·65	38·81
Pomeroy Ridge	67	17	16	221·41	42·47
St. Charles	70	14	16	101·08	30·44
St. Isidore	73	17	10	97·10	19·39
Salisbury	66	20	14	145·35	46·31
Siegas	71	12	17	114·61	28·59
Silver Falls	59	21	20	273·43	146·10
Average	64·6	19·8	15·6	142·74	46·59

SOURCES OF REVENUE

A summary of revenue and expenses is made up for each station at the end of each year from weekly accounts of all receipts and expenses. From these figures, Figure 24(*a*) has been drawn up to show the sources of revenue. The figures are for an eight-year period, 1938-1946, and for an average of fifteen farms. In interpreting this chart it should be remembered that cash receipts only are taken into consideration and no attempt has been made to place a value on home-grown grains fed to livestock.

Figure 24(a)—Sources of Revenue, New Brunswick Illustration Stations, 1938-1946



Soil Fertility Studies

PLANT FOOD DEFICIENCY

An experiment started in 1939 on four Illustration Stations was designed to test the reaction to treatments of nitrogen, phosphorus and potash applied singly and in various combinations. Treatments were made on the basis of 1,000 pounds per acre of a 5-10-5 formula. No manure was applied to this section of the test. Another series of plots included in the test was designed to show the effects of farm manure when used alone and when used in combination with superphosphate, limestone and various rates of the 2-12-6 formula. In all cases, treatments were applied in the hoed crop year (swede turnips) and yield records were obtained from this crop, also from the oats, clover and timothy which followed in the rotation. Detailed results of this test are given in Table 37. Results can be summarized briefly as follows:

(1) Nitrogen and potash applied singly gave only slight increases in the root crop and oat crop and had practically no residual effect on the following hay crops.

(2) Phosphorus applied singly and in combination with the other two elements gave good results with root crops and oat crops but only slight gains in the succeeding hay crops.

(3) Manure at 10 tons per acre compared favourably with 1,000 pounds 5-10-5 for the root crop and was more effective in maintaining yields of succeeding crops. This effect was more pronounced than yield records indicate in that the quality of hay on manured areas was much superior to that on areas which received fertilizers only.

(4) Manure supplemented by 480 pounds superphosphate per acre gave only slightly better results than manure alone.

(5) Limestone gave slightly improved yields for all crops but was most effective for the clover crop, improving both yield and quality. Three tons per acre was more effective than the one-ton application.

(6) The 2-12-6 formula proved very effective for increasing the yield of root crops. The heaviest application, 1,600 pounds per acre, also gave improved oat yields and slightly better returns for hay.

This test was carried out at Pomeroy Ridge, Salisbury, Currieburg and St. Isidore, covering a wide range of soil types. Despite this fact, the reaction to each treatment was quite similar at each station. Yields at the St. Isidore station, especially of hay, were exceptionally poor thus reducing the average

TABLE 37.—PLANT FOOD DEFICIENCY STUDY—
NEW BRUNSWICK ILLUSTRATION STATIONS
1939-1947

Treatment per acre	Crop			
	Turnips (Tons)	Oats (bu.)	Clover (tons)	Timothy (tons)
	Number of Tests*			
	7	7	7	8
1. Check	11·41	35·6	0·32	39
2. Superphosphate only—500 lb	17·12	39·9	0·34	43
3. Muriate of potash—100 lb	12·16	37·9	0·30	45
4. 1000 lb. 0-10-5	19·35	43·2	0·42	56
5. Sulphate of ammonia—250 lb	14·37	37·9	0·34	40
6. 1000 lb. 5-10-0	18·19	36·7	0·30	37
7. 1000 lb. 5-0-5	13·97	36·7	0·35	51
8. 1000 lb. 5-10-5	19·03	41·8	0·38	40
9. Manure 10 tons	18·13	44·0	0·69	58
10. Manure 10 tons + 480 lb. superphosphate	18·96	45·1	0·62	62
11. Manure 10 tons + 1 ton ground limestone	18·50	47·2	0·80	61
12. Manure 10 tons + 3 tons ground limestone	19·34	49·3	0·88	72
13. Manure 10 tons + 400 lb. 2-12-6	20·36	46·6	0·71	73
14. Manure 10 tons + 800 lb. 2-12-6	22·09	45·8	0·74	72
15. Manure 10 tons + 800 lb. 2-12-6 + 3 tons ground limestone**	22·31	48·1	0·69	63
16. Manure 10 tons + 1600 lb. 2-12-6	24·09	51·9	0·71	80

* Number of tests = Number of stations where tests are conducted by number of years yields have been taken from test.

** Limestone applied only to second turn of rotation.

figures presented in the table. In general, it can be concluded that for best returns from all crops in the rotation a liberal manure supply is essential. This should be supplemented with limestone and commercial fertilizers, preferably a complete formula.

POTATO FERTILIZER REQUIREMENTS

Of all the farm crops grown in New Brunswick, the potato gives the most profitable response to liberal feeding. This has resulted in the use of heavy applications of commercial fertilizers especially in the areas where potatoes are grown on a commercial scale. This practice has proved to be profitable under the price relationship which has existed between fertilizer and potato prices during the past few years. However, the margin is narrow (see Figure 24(*b*)) and any sizable drop in potato prices or increase in fertilizer prices or both would soon wipe out the extra returns from heavy fertilizer applications. Because of the ease with which fertilizers are applied and the satisfactory results usually obtained, there has been a tendency to use them very freely and in many cases to neglect the barnyard manure on hand. The value of manure in providing organic matter, retaining moisture, converting plant food to available forms

and maintaining the soil in good tilth cannot be stressed too strongly. Figures 24(*b*) and 24(*c*) indicate the effect of manure on potato yields when used in combination with various fertilizer treatments. An application of ten tons of manure per acre has resulted in a very marked increase in the yield of potatoes, an effect which is continued on succeeding crops. Additional nitrogen in the formulae has also had a very beneficial effect.

Figure 24(*b*) is based on results of a test which has been in progress for the last three years at the Centreville Illustration Station on a soil classified as a Caribou loam. This soil type predominates throughout the potato growing districts of Carleton and Victoria counties and is also quite common in Madawaska and Restigouche counties.

Included also in this test are a number of formulae with varying quantities of phosphoric acid and potash. Figure 24(*c*) illustrates the results obtained based on a three-year average.

Two trends are indicated in these results. First, as the phosphoric acid is increased, yields are increased, and second, when potash is increased above the five per cent level yields are decreased. These trends are gradual and steady on manured areas. However, on unmanured areas it will be noted that while highest returns for the three potash levels came from the five per cent potash level, lowest yields came from the ten per cent level with the fifteen per cent level midway between the two.

These data are for a three-year period only, but the trends noted are in keeping with results obtained in the State of Maine on a similar soil type. In order to obtain additional information on the rates and formulae under test, this experiment is being continued.

EFFECT OF SOIL TREATMENT ON QUALITY OF POTATOES

The consumer prefers a potato which when cooked is dry and mealy. It has been found that this quality in the potato is closely associated with its starch content, a high starch content indicating the desired quality in the cooked potato. In order to determine the effect of soil treatments on the starch content of the crop, numerous samples have been tested from experimental plots on various Illustration Stations throughout the province. Details are given in Table 38. The results can be summarized as follows:

TABLE 38.—EFFECT OF MANURE AND COMMERCIAL FERTILIZER ON THE STARCH CONTENT OF POTATOES

New Brunswick Illustration Stations

Treatment per acre	Number of Samples Tested	Average Starch Content in Per Cent	Average Yield per Acre
		%	bushels
Manure 10 tons—1000 lb. 4-8-10	6	16·41	266·9
Manure 10 tons—2000 lb. 4-8-10	6	15·06	295·2
Manure 20 tons	5	18·56	217·2
1500 lb. 4-8-10	5	16·46	209·5
Manure 10 tons—1500 lb. 4-10-0	6	18·65	252·4
Manure 10 tons—1500 lb. 4-10-6	6	17·39	278·0
Manure 10 tons—1500 lb. 4-10-12	6	15·55	260·4
2000 lb. 4-8-5	3	15·06	299·2
2000 lb. 4-8-15	3	14·05	275·1
Manure 10 tons—1500 lb. 4-0-10	4	16·47	227·7
Manure 10 tons—1500 lb. 4-16-10	4	17·12	264·3

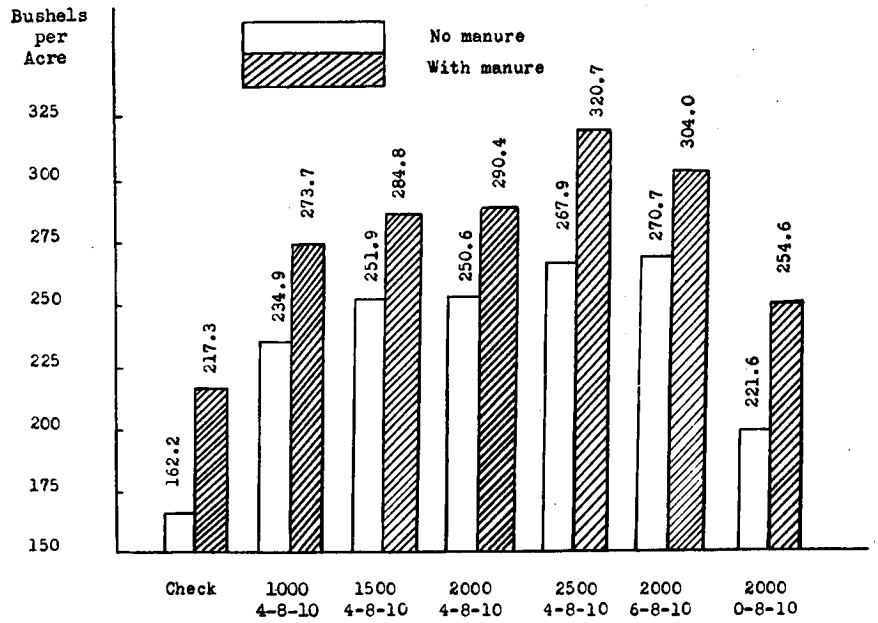


Figure 24(*b*)—Average results—Fertilizer rate test with potatoes, East Centreville Illustration Station, 1945-1947

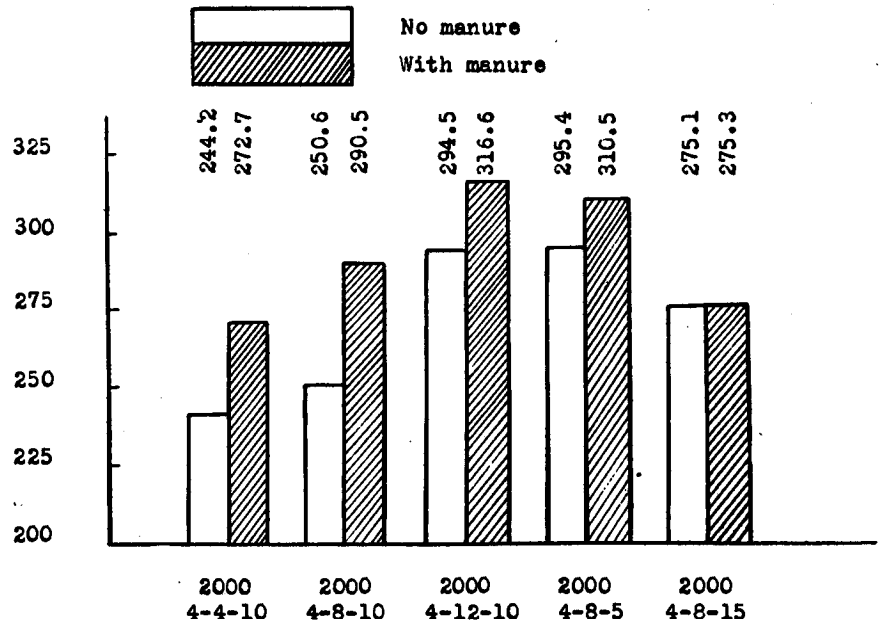


Figure 24(*c*)—Average results—Fertilizer formulae test with potatoes, East Centreville Illustration Station, 1945-1947

(1) Manure applications result in a higher starch content in the crop, thereby improving the quality of the potatoes.

(2) Heavy applications of chemical fertilizer in the absence of manure decrease the quality of the potatoes.

(3) As the potash content of the fertilizer is increased the quality of the potato decreases.

(4) Nitrogen and phosphoric acid do not appear to have any pronounced effect upon starch content.

LIMESTONE

In order to measure the effect of varying rates of limestone on the clover crop, a test was carried out on twelve Illustration Stations comparing no limestone with one ton, two tons and three tons per acre applications. Yield records from the clover crop which followed showed increased yields wherever lime had been applied. At some stations, notably Currieburg, Petersville and St. Charles, yields were more than doubled as a result of the one-ton application. The average yield for twelve stations showed the following: no limestone, 1·30 tons; one ton limestone, 1·88 tons; two tons limestone, 1·96 tons and three tons limestone, 2·11 tons. Yield records were taken from the same fields five and six years later and gave similar results. No records were taken for the timothy crop. However, it was noted at cutting time that this crop also responded favourably to the limestone treatment.

The value of lime in increasing yields of clover hay in the common grain and hay rotations has been well proven by many experiments. However, when the rotation includes a crop of potatoes, the problem of how to raise a good crop of clover becomes more difficult. Because the use of lime in amounts which give maximum returns with clover brings about a soil condition which favours the development of the potato scab organism, applications of lime at

Figure 25—Potato storage, East Florenceville, N.B.

these rates are unsafe in a potato rotation. Nevertheless, there are cases where heavy applications of commercial fertilizer in a short rotation, and continued removal of crops over a relatively long period without replenishing the lime content of the soil, has left the land so strongly acid that it is now impossible to secure a good catch of clover.

A limited number of tests have been carried out using light applications of limestone in order to counteract acidity sufficiently to obtain a satisfactory clover crop in a potato rotation. At the Centreville and St. Charles stations finely ground dolomitic limestone has been applied, at the rate of 500 pounds per acre, in a three-year rotation of potatoes, oats and clover. The limestone is applied following the potato harvest, consequently two years elapse before the area is in potatoes again. This test, begun in 1942, has given excellent results to date. Clover yields have been doubled at both stations, potato and grain crops are also showing improved yields on the limed areas. To date there has been no scab as a result of limestone treatments at the above rate. Fertilizer treatment has been the same on limed and unlimed areas, namely, one ton of 4-8-10 applied to the potato crop.

It is recognized that the problem of lime-use in conjunction with potato production requires further study. All the dolomitic limestone used in these experiments was finely ground, a fact which is quite important in relation to scab occurrence. The possibility of using larger amounts than indicated here should undoubtedly be investigated. Nevertheless, the above results indicate that a more widespread use of limestone, even in small amounts, would be beneficial in obtaining better clover sods, thereby improving the organic-matter content and physical condition of the soil.

FERTILIZER FORMULA FOR PASTURES

A test comparing five fertilizer treatments has been in progress on twelve Illustration Stations for the past number of years. The treatments and average results to date are as follows:

Treatment	*Average yield 36 tests, Tons green grass per acre*
1. 1,000 lb. 0-12-6 (every 3 years) plus 100 lb. sulphate of ammonia (yearly)..	7·80
2. 1,000 lb. 0-12-6 (every 3 years).....	7·05
3. 1,000 lb 0-12-0 (every 3 years).....	6·51
4. 333⅓ lb. 0-12-6 (yearly) plus 100 lb. sulphate of ammonia.....	7·84
5. 1,000 lb. 2-12-6 (yearly).....	8·68
6. Check—No fertilizer.....	4·50

The above are average yields for all stations over a period of years. For individual station yields see Table 39. The above results show the importance of a complete fertilizer; 600 pounds superphosphate alone applied every three years (plot 3) increased production by two tons per acre. The addition of 120 pounds muriate of potash every three years (plot 2) resulted in a further increase of ·54 tons per acre. When 100 pounds sulphate of ammonia was added yearly (plot 1) production was further increased by ·75 tons per acre. The fourth plot received the same total amount of fertilizer as the first but mineral fertilizers were applied in small yearly amounts. Note that average yields for the two are the same indicating that mineral fertilizers can be applied by either method with equal results. Nitrogen, however, gives best returns when applied annually, preferably in the spring. The last treatment, 1,000 pounds 2-12-6 annually, is the heaviest application. Although it shows the greatest yield, it is doubtful that applications at this rate are profitable

TABLE 39.—CHEMICAL FERTILIZERS FOR PASTURES—STUDY OF FORMULAE YIELDS IN TONS OF GREEN HERBAGE
New Brunswick Illustration Stations—1944-1947

Station	Number of Years in Progress	1000 lb. 0-12-6 (every 3 years) plus 100 lb. Amm. Sulphate (annually)	1000 lb. 0-12-6 (every 3 years)	1000 lb. 0-12-0 (every 3 years)	333⅓ lb. 0-12 6 (annually) 100 lb. Amm. Sulphate (annually)	1000 lb. 2-12-6 (annually)	Check (No fertilizer)
		Average	Average	Average	Average	Average	Average
Black River Bridge..	3	5·12	6·07	3·92	5·99	5·87	2·60
Crockett.....	3	12·57	9·57	8·70	12·40	11·97	6·41
Currieburg.....	3	6·46	6·16	6·74	6·67	6·30	3·33
East Centreville....	4	9·20	8·09	7·65	9·48	10·66	5·36
Guercheville.....	2	10·46	11·63	10·27	11·05	13·50	6·23
Mont Carmel.....	3	3·76	3·60	4·38	5·59	5·54	3·17
St. Charles.....	1	1·02	1·25	1·53	1·63	1·74	0·96
St. Isidore.....	3	5·35	5·03	5·69	3·78	7·26	3·42
Sackville.....	3	13·50	11·20	11·94	13·67	12·43	7·84
Salisbury.....	3	4·80	3·08	2·89	2·74	4·23	2·38
Siegas.....	4	9·34	8·85	6·80	8·10	8·11	5·31
Silver Falls.....	4	7·49	6·83	5·44	8·91	11·96	4·63
Average all tests to date (36).....	.....	7·80	7·05	6·51	7·84	8·68	4·50

except possibly as an initial treatment or under conditions such as exist at Silver Falls, near Saint John. Here, due to frequent fogs, pastures seldom dry up during July and August. This results in greater utilization of the plant food and the average yield for the heavy application at this station is three tons per acre higher than for the lighter treatment.

RENEWING POOR SODS

It has been found that on many pastures on which sods have become thin and worn out, fertilizer applications alone are not sufficient to bring the pasture back into profitable production. A pasture of this type was used at the Hampstead Illustration Station to carry out a series of treatments including ploughing, harrowing, reseeding, liming and fertilizing. The test was started in 1941 and yield records for the five-year period 1942-1947 show a decided increase in production on those areas which had been ploughed or harrowed with reseeding, liming and fertilizing as compared with plots which received lime or fertilizer sown on the surface in the usual way.

TABLE 40.—PASTURE SEEDING AND MANAGEMENT STUDIES

Treatment	Average Yield Green Grass per Acre 1942-1947 Tons	Average Composition of Herbage		
		Clovers	Grasses	Weeds
		%	%	%
1. Plough and reseed, 1 ton limestone + fertilizer*.....	7·44	33	58	9
2. Harrow and reseed, 1 ton limestone + fertilizer*.....	7·09	49	45	6
3. Surface application of fertilizer*.....	4·17	30	58	12
4. Surface application of 1 ton limestone (1943) no fertilizer..	1·30	17	63	20
5. Check.....	1·12	3	61	36

* Fertilizer treatments were identical on each plot and were as follows: 1941, 300 lb. 5-10-5 mixture 1942-43-44, 140 lb. superphosphate and 50 lb. muriate of potash; 1945-46-47, 300 lb. 4-12-6 per acre.

A mixture of timothy, red and alsike clover was used in reseeding with the result that red and alsike clover predominated in the first two years on these areas; however, wild white clover has since taken over. Average yields and percentage of grass, clover and weeds for some of the treatments are shown in Table 40.

The past two seasons have been exceptionally dry in this district resulting in comparatively light yields on all plots. There is, however, a good sod on the plots which were given cultural treatment plus reseeding and it is expected that with favourable weather production will remain at a high level for some years to come. In order to obtain additional information on building up pasture sods, similar treatments are now in progress at other stations where surface applications of limestone and fertilizer have failed to bring about satisfactory results.

CRANBERRIES

ESTABLISHING CRANBERRY BOG

Cranberry studies were started in the fall of 1941 on the Cumberland Point Illustration Station. The farm slopes gently to the north and is located on the southeast shore of Grand Lake, directly across from Minto. The land is a heavy clay loam, with several pockets or basins which are miniature swamps and in which decayed organic matter has accumulated to a depth of from one inch to a foot. During cool periods, the prevailing north or westerly winds blow from the lake and thus provide a long frost-free season.

A bog of between two and three acres, only about six feet above the summer level of Grand Lake was chosen for the main experimental area. The subsoil beneath this bog is a stiff, blue brick clay. The top soil is clay loam mixed with a thin layer of peat. The bog was covered by coarse grass with a few sedges and iris. Since the level was already low and the peat layer shallow, it was decided to prepare for planting by cutting the sod in strips and turning it completely under. A border ditch was cut entirely around this section and the outlet opened to the lake. This was done in the fall of 1941. Coarse sand was hauled from the lake shore and spread evenly to a depth of three inches the following winter.

Disease-free vines were imported and set out in the spring of 1942. One-half the area was set to Early Black and one-half to Howes, the total area being two thirds of an acre.

Careful records have been kept of the time spent in clearing, ditching, turfing and sanding the bog. A total of 1,037 man hours and 65 team hours were required to prepare the bog for planting. Since then a concrete sluice has been built to hold winter flood water and periodically it has been found necessary to weed, clean ditches and resand.

On a level too high to be flooded from the lake, the operator has developed part of another smaller bog. The total area of this bog is about one quarter acre. One-half was ditched, turfed and graded in 1940. This one-half acre was sanded and about two-thirds was planted in 1941, the balance in 1942, using native, wild vines.

The first berries were picked in 1945, when the yield was about 200 pounds from the two bogs. In 1946 it increased to 1,300 pounds and in 1947 a total of 3,300 pounds was harvested.

The Early Black variety has ripened some ten days earlier than Howes and has been a better colour at picking time. The Howes, however, developed excellent colour in storage. Yields on this half of the bog have been higher each year in the relation of three to two. In 1946 a consumer preference for

the Early Black was reported from the purchaser when berries were marketed immediately following picking. The uniformity within each variety is noticeable when compared with fruit of native, unselected plants.

In preparing the second bog, a test was carried out on an adjoining area with chemical weed killers. Although final sanding and planting was not completed on this portion of the bog, it was found that an application of 320 pounds of ammonium sulphamate in the spring followed by a spot treatment later in the summer on the remaining living plants resulted in a complete kill of all vegetation. There is every indication that this method of preparing a bog has possibilities but further investigations are required.

WEED CONTROL FOR CRANBERRY BOGS

Considerable difficulty has been experienced in keeping a newly planted bog free from weeds such as coarse grasses, sedges and shrubs which have been the most numerous. Hand weeding is difficult and costly because of the tangle of vines. Consequently a test was carried out in 1947 using white kerosene. Applications were made at a 200-gallon and a 400-gallon per acre rate and the results indicate that this method is very effective. Practically all grasses and sedges were killed even at the lower rate while there was no apparent injury to the cranberry vines. Applications were made with an ordinary watering can and it would appear because of the cost of material that the most economical method would be to spot spray areas where weeds are serious, rather than make a general application over the entire area.

Farm Wood-lot Management

Studies carried out by the Department of Lands and Mines and the Dominion Forest Service reveal that farm wood-lots in New Brunswick are being seriously depleted. In an effort to demonstrate methods of conserving wood-lots and increasing the growth rate, the wood-lot on the Experimental Station, Fredericton, and four farm wood-lots on the Illustration Stations at Currieburg, Mont Carmel, St. Isidore and Siegas were placed under management in 1944. The project is a co-operative one carried on with the Dominion Forest Service.

In each case, lines were established and painted dividing the wood-lot into ten compartments of equal size. A cruise was made of each compartment, growth was determined and a ten-year cutting cycle adopted. Each year a compartment is cut, removing mature and over-mature trees as well as poorly formed or otherwise undesirable trees. At the end of the ten-year cycle the working plan will be revised. By following selective cutting methods, more room is left for young trees of a desirable species to grow and put on wood more rapidly, the principle being the same as for other farm crops, that is, choosing the most suitable and valuable variety and giving it room to grow. When such a plan is adhered to, the farm wood-lot will produce each year a crop of valuable wood products and will become as it should be a vital part of the farm enterprise.

ACTIVE PROJECTS

DOMINION EXPERIMENTAL STATION

FREDERICTON, N.B.

DECEMBER, 1947.

ANIMAL HUSBANDRY

CATTLE

A 58	Record of Performance.
A 59	Cost of rearing dairy-bred calves and heifers.
A 93	Control of tuberculosis in cattle.
A 217	Cost of maintaining herd sires.
A 456	Periodic costs of rearing dairy males.
A 502	Breeding Holstein cattle.
A 660	Serum test for contagious abortion.
A 803	Rates of applying fertilizer for pastures.
A 813	Feed cost of milk and butterfat production.
A 814	Eradication of mastitis in the dairy herd.
A 878	Artificial insemination of cattle.
A 916	Loss in ensiling various crops.

HORSES

A 293	Cost of horse labour.
A 294	Periodic cost of rearing draft horses.
A 331	Cost of maintaining work horses.
A 336	Cost of maintaining brood mares.
A 531	Breeding Percheron horses.

SWINE

A 157	Cost of rearing sows to breeding age.
A 158	Cost of feeding brood sows.
A 160	Cost of rearing pigs to time of weaning.
A 163	Cost of pork production.
A 166	Cost of maintaining herd boar.
A 513	Breeding Yorkshire swine.
A 679	Advanced Registry Policy for purebred swine.
A 858	Fecundity and nursing capacity in swine.
A 877	Brooder for young pigs—electrically heated.
A 919	Prepotency testing of boars.

FIELD HUSBANDRY

F 86	Yield and profit from various grain crops.
F 87	Yield and profit from various hay crops.
F 88	Yield and profit from roots and silage crops.
F 90	Cost of operating tractors.
F 305	Meteorological records.
F 326	Potatoes continuously versus potatoes in rotation.
F 353	Manure and commercial fertilizer combinations for hay.
F 355	Manure and commercial fertilizer combinations for oats.

Field Husbandry—*Conc.*

F 369	Commercial fertilizer formulae for pastures.
F 370	Date of applying commercial fertilizer for pastures.
F 371	Rates of applying fertilizer for pastures.
F 388	The use of chemicals for weed control.
F 407	Rate of applying commercial fertilizer for root crops.
F 477 and A 916	Losses in ensiling various crops.

Horticulture

H 21	Strawberries, variety test.
H 102	Corn, variety experiment.
H 298	Hedges, variety experiment.
H 777	Nutrition studies with horticultural crop plants.
H 777	(a) Mulches for apple trees.
H 790	Flowering and ornamental shrubs, variety experiment.
H 793	Bush fruits, variety experiment.
H 806	Solanaceous vegetables, variety experiment.
H 815	Tree fruits, variety experiment.
H 822	Solanaceous vegetables, breeding and selection.
H 827	Tree fruits, breeding.

Cereal

Project No. 1	Ce 1.	Spring wheat.
	Ce 5.	Oats.
	Ce 6.	Barley.
	Ce 7.	Field peas.
	Ce 8.	Field beans.
	Ce 12.	Buckwheat.
	No. XIII	Registered seed.

Forage

Ag. 1	Indian corn variety test for ensilage purposes.
Ag. 16	Root variety test (swede and mangel sections).
Ag. 55	Swede—club-root resistance.
Ag. 58	Swedes—seed production.
Ag. 155	Red clover seed production.
Ag. 181	Soybeans—variety test for forage and seed.
Ag. 202	Timothy seed production.
Ag. 246	Annual hay crops.
Ag. 255	Forage crop nursery.
Ag. 264	Perennial and biennial grasses and legumes for hay.
Ag. 267	Perennial and biennial grass and legumes for pasture.

Poultry

P 56	Pedigree breeding for egg production.
P 56B	The evaluation of the breeding potential of full sisters.
P 111	Breeding for hatchability and viability.

ILLUSTRATION STATION PROJECTS

IS-El.31	Hoed crop—cereal (s)—clover.
IS-El.42	Hoed crop—cereal (s)—clover—timothy.
IS-El.51	Hoed crop—cereal (s)—clover—timothy—timothy.
IS-El.62	Hoed crop—cereal (s)—clover—timothy—timothy or pasture—cereal.
IS-02.01	Plant food deficiency studies (eastern).
IS-02.03	Chemical fertilizer as a supplement to farm manure (formulae test).
IS-02.03B	Chemical fertilizer as a supplement to farm manure (rate of application).
IS-02.03C	Chemical fertilizer as a supplement to farm manure (Place in rotation when hoed crop grown).
IS-02.04	Chemical fertilizers: study of formulae.
IS-02.08	The effect of ground limestone on farm crops.
IS-02.09	Nitrogenous fertilizers for hay lands.
IS-03.01	Control of weeds by cultural methods.
IS-03.02	Control of weeds by chemicals.
IS-03.03	Contour farming.
IS-04.05	Water erosion control.
IS-04.08	Whitewashing and painting of farm buildings.
IS-07.01	Testing mixtures for hay or pasture.
IS-08.02	Chemical fertilizers for pasture: study of formulae.
IS-08.06	Pasture seeding and management studies.
IS-09.10	Making grass and legume silage.
IS-10.01	Growing certified seed potatoes.
IS-10.02	Growing tuber unit seed potatoes in isolated plots.
IS-11.02	Stimulating interest in the development of the farm garden.
IS-11.06	Fruit tree root and framework stock test.
IS-12.16	Methods of weed control on cranberry bogs.
IS-12.17	Cranberry production on unland areas.
IS-13.01	Dairy cattle production.
IS-13.05	Sales of livestock for breeding purposes.
IS-13.07	Swine production.
IS-13.08	Sheep production.
IS-14.01	Poultry production.
IS-17.02	Cost of producing milk.
IS-17.03	Studies of various defects in regional farming. (Study of farm productivity and progress).
IS-17.04	Study of farm business.
IS-17.09	Management of the farm wood-lot.
IS-19.01	Field days.
IS-19.02	Publications and presentation of results.

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