CANADA
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS SERVICE

DOMINION EXPERIMENTAL STATION

KENTVILLE

N.S.

A. KELSALL, B.S.A., SUPERINTENDENT

PROGRESS REPORT
1937-1946

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

DOMINION EXPERIMENTAL STATION

Kentville, N.S.

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Introduction

The Dominion Experimental Station at Kentville, Nova Scotia, was established in 1911 primarily to assist fruit growers in Kings, Annapolis and Hants counties. Although the Station is concerned mainly with horticulture, experimental projects are conducted also in animal husbandry, beekeeping, field husbandry and poultry.

A general progress report of the Experimental Station at Kentville was published in a six-year summary of experimental results, 1931-1936. In the present progress report are published the most important features of the experimental program from 1937 to 1946, inclusive. Progress reports such as this will be published at suitable intervals, likely every three years. When an important investigation is completed, and results of value are obtained, these will be published separately without waiting for their inclusion in a progress report. In this way information of value will be made quickly and readily available.

A new mailing list is being established and those whose names are on it will receive special reports in which they may be interested as well as the general progress reports. Further details concerning the investigational work described, or information pertaining to the general field in which this work was done, may be obtained by writing to the Dominion Experimental Station, Kentville, N.S.

Fig. 2—Lawn and Superintendent's Residence, Experimental Station, Kentville, N.S.

The Weather

The following tables, showing dates of full bloom of certain varieties of apples, and annual precipitation, sunshine, etc., may be of interest to fruit growers and others.

During World War II the collecting and distributing of meteorological data came under the control of the Division of Transport, and it is with their co-operation since then that the weather records have been collected.

TABLE 1. METEOROLOGICAL RECORDS, 1914–1946

((33 YEARS)

Month	Temperature			Precipitation			Sunshine
	Highest	Lowest	Mean	Rain	Snow	Total	
	F.	F.	F.	in.	in.	in.	hr.
January	60	–22.5	20.57	1.96	19.10	3.87	78.5
February	60	–24	20.11	1.31	19.90	3.29	96.9
March	72	–15	29.26	1.88	12.40	3.12	133.6
April	80	5	39.47	2.33	4.50	2.78	152.8
May	89	18	50.43	2.69	0.14	2.71	201.2
June	95	30	59.46	2.96	....	2.96	203.1
July	95	37	66.25	2.93	....	2.93	231.9
August	100	36	65.02	3.28	....	3.28	220.1
September	91	26	57.91	3.55	....	3.55	169.0
October	83	18	48.04	4.25	....	4.25	135.6
November	70	3	37.28	3.57	5.10	4.08	82.9
December	64	–14	25.32	2.27	17.20	3.98	56.5
Annual	100	–24	43.26	32.98	78.34	40.80	1,762.10

Highest temperature in 33 years, 100° F., August 12, 1944.

Lowest temperature in 33 years, –24° F., February 1, 1920.

On December 29, 1933, the temperature fell to –12° in the early morning (before daylight), and did not go above –7° all day. This was in the very cold winter of 1933–1934.

TABLE 2. ANNUAL PRECIPITATION (INCHES), 1914–1946
(33 YEARS)

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1914	2.18	2.59	3.73	2.33	1.46	4.29	1.45	2.58	3.65	1.90	3.22	2.59	32.60
1915	4.74	1.25	0.95	1.70	2.50	2.43	1.52	3.84	0.85	3.88	2.81	3.88	30.35
1916	1.80	4.17	4.06	2.34	1.78	3.69	2.66	1.86	1.74	5.38	3.48	4.50	36.46
1917	3.93	3.69	3.01	4.37	2.92	2.93	3.65	5.15	3.72	8.54	3.03	4.49	49.45
1918	2.18	3.44	2.17	1.43	1.21	2.30	4.99	1.72	8.06	4.36	4.14	3.25	39.25
1919	4.73	1.94	2.38	3.28	2.48	2.25	2.77	2.21	3.13	3.93	7.27	3.56	39.93
1920	2.91	4.83	3.04	3.66	1.69	2.98	2.70	3.58	2.99	0.69	3.30	3.90	36.27
1921	2.01	4.22	3.02	3.91	1.91	1.93	2.04	0.93	1.82	3.10	6.88	3.26	35.03
1922	3.18	2.96	2.35	2.46	1.51	2.48	5.63	5.56	2.71	6.38	2.37	4.81	42.40
1923	5.87	2.12	4.59	3.24	2.34	3.54	2.32	4.03	3.93	3.05	5.60	4.75	45.38
1924	5.06	1.35	1.63	2.91	0.67	4.44	0.99	6.36	2.02	3.00	2.75	2.80	33.98
1925	3.06	2.13	3.04	1.99	2.37	4.97	3.34	1.42	2.11	6.44	3.54	1.76	36.17
1926	4.84	6.57	3.79	3.52	3.75	3.33	2.98	1.85	1.00	4.63	3.10	4.60	43.96
1927	4.42	3.46	2.46	3.37	3.73	1.27	5.58	9.39	2.07	5.23	2.37	4.39	47.74
1928	4.23	2.99	3.05	2.18	3.16	1.88	3.32	1.02	2.76	3.12	3.21	5.45	36.37
1929	4.99	3.73	2.81	2.78	6.52	2.30	1.60	2.32	4.46	2.40	3.63	3.99	41.53
1930	3.14	3.56	3.73	1.60	1.61	1.71	3.71	2.07	0.92	3.33	1.74	4.95	32.07
1931	3.69	3.12	3.03	3.81	2.59	4.57	2.15	3.54	4.81	2.16	1.87	4.06	39.40
1932	4.00	2.47	3.21	2.76	1.30	2.12	3.47	3.26	3.95	3.23	4.40	3.04	37.21
1933	4.86	3.77	4.56	2.87	2.32	3.14	2.06	5.24	5.79	11.69	6.36	3.71	56.37
1934	2.84	5.85	3.52	2.95	1.57	1.19	5.52	0.52	3.21	3.34	7.71	5.63	43.85
1935	8.69	3.12	2.89	1.83	1.47	2.76	2.49	4.52	4.73	2.61	3.95	4.40	43.46
1936	5.65	1.21	4.35	3.00	4.18	2.78	2.16	2.94	6.91	6.32	4.32	5.03	48.76
1937	3.57	2.63	2.70	2.27	3.25	4.82	0.67	4.32	4.22	3.91	3.43	4.50	40.29
1938	2.91	4.52	2.54	2.44	2.22	4.33	6.72	4.25	4.22	2.31	4.72	3.36	44.88
1939	3.66	2.77	4.36	4.51	1.93	1.18	2.63	1.91	2.53	5.02	1.14	3.83	35.47
1940	2.24	1.99	2.74	2.78	2.46	2.80	2.16	1.66	6.66	2.74	5.54	4.81	38.58
1941	4.61	1.98	4.85	1.99	5.83	2.65	2.15	3.80	2.00	5.12	4.66	4.36	44.00
1942	5.27	2.78	4.09	2.27	2.12	1.58	2.00	2.11	10.58	5.85	4.09	3.75	46.49
1943	1.61	3.98	3.59	1.64	4.11	4.59	5.52	6.60	2.71	4.11	6.03	1.51	46.00
1944	1.30	5.51	2.04	2.54	0.22	2.88	2.30	3.02	3.33	4.31	4.85	3.89	36.19
1945	4.97	3.78	1.65	1.89	7.66	6.32	1.48	2.18	1.77	5.81	7.05	3.65	48.21
1946	4.07	4.23	1.11	4.95	2.57	1.03	1.94	3.56	2.91	2.50	2.18	5.00	36.05
Average (33-years)	3.87	3.29	3.06	2.77	2.65	2.95	2.93	3.31	3.58	4.25	4.08	3.98	40.73

TABLE 3. DATES OF FARM OPERATIONS, 1937–1946

(10 YEARS)

	Earliest	Latest	Average
Spring ploughing	April 15 (1943)	May 9 (1939)	April 25
Seeding wheat	April 29 (1937)	May 23 (1940)	May 10
Seeding oats	April 29 (1942)	May 27 (1940)	May 11
Livestock put out on pasture	May 15 (1942)	May 27 (1938)	May 21
Seeding corn	June 1 (1942)	June 8 (1943)	June 5
Cutting grass for hay	June 25 (1942)	July 10 (1940)	July 2
First cutting alfalfa	June 30 (1946)	July 10 (1945)	July 3
Second cutting alfalfa	Aug. 2 (1941)	Sept. 10 (1940)	Aug. 28
Cutting wheat	Aug. 5 (1944)	Sept. 10 (1938)	Aug. 26
Cutting oats	Aug. 3 (1944)	Sept. 3 (1941)	Aug. 19
Cutting corn	Sept. 8 (1944)	Sept. 28 (1940)	Sept. 19
Livestock taken off pasture	Oct. 7 (1937)	Oct. 27 (1944)	Oct. 18
Date of freeze-up	Nov. 15 (1937)	Dec. 20 (1946)	Nov. 27

TABLE 4. DATES OF FULL BLOOM OF APPLE TREES, 1924–1946

(23 YEARS)

Year	Gravenstein	Wagener	McIntosh	Northern Spy
1924	June 3	June 5	June 7	June 10
1925	June 5	June 7	June 8	June 8
1926	June 12	June 13	June 14	June 17
1927	June 7	June 9	June 11	June 13
1928	May 31	June 3	June 3	June 6
1929	June 2	June 6	June 6	June 7
1930	May 27	June 3	June 2	June 4
1931	May 26	May 27	May 28	May 31
1932	May 31	June 1	June 1	June 6
1933	May 31	June 2	June 2	June 6
1934	May 28	May 29	May 27	May 31
1935	June 4	June 5	June 3	June 8
1936	May 22	May 24	May 25	May 28
1937	May 27	May 29	May 28	June 1
1938	May 29	June 2	June 2	June 5
1939	June 5	June 6	June 7	June 12
1940	June 2	June 3	June 3	June 8
1941	June 4	June 4	June 5	June 9
1942	May 24	May 24	May 25	May 29
1943	June 4	June 6	June 6	June 10
1944	May 28	May 28	May 30	June 1
1945	May 25	May 26	May 28	June 9
1946	May 27	May 27	May 30	June 2

Earliest—May 22, 1936; May 24, 1936; May 25, 1936; May 28, 1936.
Latest —June 12, 1926; June 13, 1926; June 14, 1926; June 17, 1926.
Average—May 31 June 2 June 2 June 6.

TABLE 5. THE OCCURRENCE OF FROST AND FROST-FREE PERIODS, 1914–1946 (33 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 4	Oct. 1	119
1915	May 17	Sept. 26	132
1916	May 22	Oct. 11	142
1917	May 12	Sept. 12	123
1918	May 5	Oct. 2	150
1919	May 17	Sept. 16	122
1920	May 31	Oct. 7	129
1921	May 24	Sept. 21	120
1922	May 28	Sept. 27	122
1923	May 30	Sept. 27	120
1924	May 22	Sept. 29	130
1925	May 20	Sept. 24	127
1926	May 7	Sept. 27	143
1927	June 3	Sept. 28	117
1928	May 9	Sept. 30	144
1929	May 11	Sept. 22	134
1930	May 30	Oct. 4	127
1931	May 13	Oct. 11	153
1932	May 30	Oct. 13	136
1933	May 28	Oct. 20	145
1934	May 20	Oct. 2	135
1935	May 18	Oct. 8	143
1936	May 27	Sept. 30	126
1937	May 3	Oct. 3	153
1938	May 20	Oct. 3	136
1939	May 27	Sept. 19	115
1940	May 12	Oct. 1	142
1941	May 12	Sept. 14	125
1942	June 2	Sept. 9	99
1943	June 15	Sept. 19	96
1944	June 5	Sept. 25	112
1945	June 9	Sept. 18	101
1946	June 2	Oct. 9	129
Average	May 23	Sept. 29	129

Date of the latest spring frost on record, June 15.
Date of the earliest fall frost on record, Sept. 9.
Shortest frost-free period on record, 96 days.
Longest frost-free period on record, 153 days.

Horticulture

Fertilizer for Orchards

(R. P. Longley)

The importance of fertilizers for orchards has long been recognized and in the fruit-growing area the fertilizer cost has been one of the major items. The 1941 census placed the expenditure for fertilizer at $450,800 for the three counties of Annapolis, Hants and Kings. It would seem a reasonable estimate that three-fourths of this fertilizer, or $338,100, was used on orchards. The area of orchards and vineyards is given at 36,732 acres, which would make the average outlay for fertilizer $9.20 per acre. Since the 1941 census, fertilizer prices and the quantities used have increased materially and it is quite probable that this amount has doubled.

When the Kentville Station was first started, a comprehensive test was made using combinations of many materials which supplied nitrogen, phosphorus, potassium and calcium. Due to the information obtained from the various tests conducted and also because of the availability and price of some materials the treatments have since been reduced to a small number. Nitrogen is now largely supplied by the use of nitrate of ammonia, sulphate of ammonia and cyanamid. Phosphorus is supplied by superphosphate and potassium by muriate of potash. Increasing amounts of limestone are being used to supply calcium, to improve the texture and to sweeten the soil. Manure is procurable to a limited extent, and is highly valued.

About 1930, a 9-5-7 formula was recommended for use on orchards and it has been widely accepted. Some growers, however, feel that it gives too little phosphorus and too much nitrogen, others consider they get no results from the potash, while still others feel that they can reduce costs by using the chemicals supplying nitrogen only, every third or fourth year.

In order that more data might be obtained on this important subject a series of tests was started in 1937 on a young orchard. The trees had been set in 1930 as interplants in an older orchard. The old trees were pulled in 1940. The land was clean-cultivated up to the trees until 1941, when the whole area was seeded and has since remained in sod. No additional mulch has been given.

The area was arranged in three tests, all of which were based on a 9-5-7 fertilizer mixture. Crimson Gravensteins were used to compare the effects of 9-5-7, 9-0-7, 9-5-0 and 9-0-0. Red Kings were used for a test of three sources of nitrogen—nitrate of soda (in 1946 nitrate of ammonia), sulphate of ammonia, and cyanamid—applied at two rates, 450 and 900 pounds per acre, in a 9-5-7 fertilizer applied in the spring and again in the fall. McIntosh and Cox Orange were present as pollinators and were used in a further study of rates of application and sources of nitrogen. The quantities again used were 450 and 900 pounds of 9-5-7, with both nitrate of soda and sulphate of ammonia as sources of nitrogen. This was a spring application only.

The orchard is on a medium slope and suffered severe erosion in some areas before sodding over was completed. While all tests are replicated the results are not as clear-cut as they might have been on more uniform land. The test on Gravensteins is not reported as the results appear indefinite at time of writing.

Tree losses all occurred where fall applications were made and, with one exception, where the trees received 900 pounds per acre. The most serious loss was in a sulphate of ammonia plot receiving 900 pounds per acre, where all four trees died. It has not been established that there was any connection between fertilizer application and the loss of the trees.

The Red Kings from these plots were scored for colour, and pressure records were taken for the 1945 crop, a year of low yields, which might make a slight difference in the quality.

TABLE 6. ORCHARD FERTILIZER: SOURCE OF NITROGEN AND TIME OF APPLICATION

Red Kings Treatment	Yield in pecks		Colour rating*	Pounds pressure to pierce skin	Area of cross-section of trunk, 1946
	1937 to 1942, incl.	1943 to 1946, incl.			
	pk.	pk.		lb.	sq. in.
Nitrate of soda	16.10	24.35	3.70	16.5	42.10
Sulphate of ammonia	18.84	22.78	3.40	16.0	42.83
Cyanamid	17.34	17.42	3.62	16.1	42.05
Spring, 450 lb. 9-5-7	16.68	17.88	3.69	16.5	39.98
Spring, 900 lb. 9-5-7	22.74	31.90	3.22	16.2	48.79
Fall, 450 lb. 9-5-7	16.00	13.85	3.78	15.6	40.16
Fall, 900 lb. 9-5-7	14.27	22.45	3.63	16.6	40.37

*(Based on U.S.D.A. colour chart, which is divided into four green shades from No. 1 to No. 4 as the shade of green lightens. The nearer to No. 4 the better the colour the apples have. It does not refer to red colour).

The average total production of Red Kings per tree from 1937 to 1946 with sulphate of ammonia as the source of nitrogen was 41.62 pecks; with nitrate of soda, 40.45 pecks; and with cyanamid, 34.76 pecks.

The plots which received spring applications in the 10 years produced with 450 pounds of 9-5-7, 34.56 pecks per tree and with 900 pounds, 54.64 pecks per tree. The fall-application plots produced, with 450 pounds per acre, 29.85 pecks per tree, and with 900 pounds, 36.72 pecks per tree.

Examination of the data appears to show that the trees did not respond to increased fertilizer applications to the same extent when small as they did when older. Table 6 divides the data into the two periods, 1937 to 1942, and 1943 to 1946. In the first period, except for an increase when a spring application of 900 pounds was given, there were no important differences. The second period shows an advantage for the heavier amount and for spring applications. These data suggest an advantage from using nitrate of soda and sulphate of ammonia rather than cyanamid as sources of nitrogen, and also that spring applications of treatments are better than fall.

There appear to be no significant differences between the three sources of nitrogen in their effect on the growth of the trees. The cross-section of the trunk was used as an index of size. The average trunk sizes of all the trees under each treatment were: nitrate of soda, 42.10 square inches; sulphate of ammonia, 42.83, and cyanamid, 42.05 square inches.

The application of 450 pounds in the spring and fall, and the 900 pounds applied in the fall, all gave trees of practically equal size, these having an average trunk cross-section of 39.98, 40.16 and 40.37 square inches, respectively. The trees which received 900 pounds of the 9-5-7 in the spring were larger, averaging 48.79 square inches.

The yields of the McIntosh and Cox Orange varieties in the other fertilizer test are given in Table 7.

TABLE 7. ORCHARD FERTILIZER: SOURCE OF NITROGEN

Treatment: all 9-5-7, all in spring	Yield in pecks			
	McIntosh		Cox Orange	
	1937 to 1942, incl.	1943 to 1946, incl.	1937 to 1942, incl.	1943 to 1946, incl.
	pk.	pk.	pk.	pk.
450 lb. (with nitrate of soda)	17.77	27.58	15.35	16.38
900 lb. (with nitrate of soda)	29.04	54.41	12.26	22.51
450 lb. (with sulphate of ammonia)	28.86	24.78	13.11	11.46
900 lb. (with sulphate of ammonia)	24.85	43.89	11.89	13.39

The nitrate of soda plots have given better yields than the sulphate of ammonia plots. The yields in the early years of the test showed no consistent results, but in the later years showed a distinct advantage for the heavier applications. The advantage was greater with McIntosh than with Cox Orange.

RATES OF APPLICATION OF ORCHARD FERTILIZER

The problem of how much fertilizer to use in orchards has worried many experimenters and growers. When apple prices are high there is a general feeling that it is economical to use large quantities so long as the quality of the apples is not seriously affected. In order that more data could be secured, an orchard at the back of the Station, planted in 1915, with a few replacements in 1917, 1919, and 1924, was selected, and a plan developed, in 1939. The predominating varieties were used for the test, consisting of three rows each of Wagener and Baldwin and one row of King. Single-row blocks were used. Each row was divided into three plots of seven trees each in the case of Wagener, which were set 54 to the acre, and three plots of four trees each in the case of King and Baldwin, which were set 27 to the acre.

Originally, there were filler trees in the King and Baldwin rows. Some of these were missing. The whole area was laid down in sod after 1941.

The plots received respectively, no fertilizer, 800 pounds of 9-5-7, and 1600 pounds of 9-5-7, per acre per year, in spring.

The analysis, shown in table 8, was made on the basis of the dates when the trees were set, and the trees from all plots that received like treatment were grouped together. The yields of the trees before the test started are given to indicate the uniformity, or lack of uniformity, of the trees used. In the Baldwins and Wageners there was reasonable uniformity, and there appeared to be no serious interference with the test from the effect of the general soil characteristics or the producing ability of the trees. In the Kings the situation was not quite so satisfactory. Previous to the test the yield of the trees receiving no fertilizer and of those receiving the 1600-pound application had been practically the same, 206.56 and 209.25 pecks, respectively. The trees which received the 800-pound application had averaged 251.56 pecks before the test started. This difference was apparently too great to be overcome by the fertilizer treatments used. The King trees that received the 1600-pound application made a showing, in comparison with the no-fertilizer trees, quite comparable with those in the Wagener and Baldwin plots.

It is realized that the check plots may obtain some fertilizer from the adjoining fertilized plots. No data are available to correct this possible weakness in the set-up of the experiment.

The records on quality for the 1946 crop of Kings indicate that the starch in the apples from the 800-pound application was greater than in the no-fertilizer or heavy-application plots.

The King apples were progressively greener as more fertilizer was applied to the plots. The pressure testing at harvest showed the apples from the no-fertilizer plot to be harder, and the others about equal. This relationship continued throughout the storage life of the apples.

On February 3 the King apples were tested for quality on the basis of texture and flavour. They were best from the no-fertilizer plot and the next best from the heavy-application plot.

With Wagener the results were similar, except that there was no difference in the pressure test at harvest and no difference in quality or rot on February 3.

The results from this test are reasonably conclusive that the higher rate of application was justified by the yield obtained.

TABLE 8. RATES OF APPLICATION OF ORCHARD FERTILIZER: AVERAGE YIELD PER TREE

Year trees set	No fertilizer			800 pounds			1,600 pounds		
	Number of trees	Average yield, before test	Average yield, 1939-1946, incl.	Number of trees	Average yield, before test	Average yield, 1939-1946, incl.	Number of trees	Average yield, before test	Average yield, 1939-1946, incl.
		pk.	pk.		pk.	pk.		pk.	pk.
Baldwin									
1915	8	272.38	166.97	9	240.39	228.36	4	284.88	318.50
1917	1	274.75	177.25	..	.....	.....	..	.....	.....
1919..	1	186.00	129.75	1	204.25	183.75	7	151.21	257.57
Wagener									
1915....	10	270.90	149.28	8	272.19	208.41	6	283.42	255.84
1917..	5	248.90	140.55	8	281.91	207.41	7	266.43	258.54
1924.....	1	45.00	72.25	2	58.88	105.00	..	.....	.....
King									
1919..,.....	4	206.56	160.38	4	251.56	312.56	4	209.25	280.38

The Use of Vegetatively-propagated Root-stocks for Apple-tree Propagation

(R. P. Longley)

In the Annapolis-Cornwallis Valley, most of the apple trees are growing on seedling root-stocks from many sources. French Crab seedlings have been used widely. Some growers produced seedlings from their own apples. Many trees originated as chance seedlings in fence rows, pastures and roadsides.

The selection of strong-growing seedlings, able to stand the competition found in the wilds resulted in free-growing trees. A height of 40 feet is not unknown, and 25- to 30-foot trees are common, particularly on the better soils and where barnyard manure has been used extensively. This study was prompted by a desire for a smaller-growing, more uniform tree which would come into production earlier.

Such vegetatively-propagated stocks had been in use in Europe for over 200 years, but they did not come into extensive use until after they had been investigated by the East Malling Research Station in Kent, England. Their work started about 1912 and early in the investigation they selected 16 different stocks or varieties, to which they assigned numbers. These rooted easily and were grouped according to the vigour of the trees produced upon them. Others have since been added, and the resulting stocks are now scattered over much of the apple-growing world.

In 1934 a comprehensive test was started, using the Malling root-stocks I, II, IX, and XII and the two seedling root-stocks, Anis and Beautiful Arcade. These six stocks were budded to Fameuse and McIntosh. Sixteen trees of each variety on each root-stock were planted in an orchard known as the Malling Block. The trees started to bear in 1938. Table 9 gives the average production for each year for each stock from 1938 to 1946.

The Malling IX stock gives severe dwarfing and early production. In this test it took the lead in production, but held it for only one year against all the other types with McIntosh, and for two years against type II and three years against I, Anis and Beautiful Arcade, with Fameuse. No. XII, which produces very vigorous trees, did not surpass IX with Fameuse until the tenth year, in 1943.

Production was light on all stocks until 1943, the tenth growing season. That year the crop on both varieties and all stocks, except McIntosh on IX, was greater than the total previous yield.

The Fameuse total fruit per tree was highest on Malling II and second highest on Beautiful Arcade. With McIntosh, Beautiful Arcade stood first, by a distinct margin, followed by Anis, XII, I, and II. With both varieties IX was the lowest, producing less than half the crop of the highest-yielding stock.

The order of average tree size, based on the area of the cross-section of trunk, was the same for both varieties, and was, starting at the largest, Malling XII, Anis, Beautiful Arcade, Malling I, II, and IX. The trees on Malling I and II were approximately two-thirds the size of the largest, on Malling XII. The seedling stocks, Anis and Beautiful Arcade, are intermediate in position between these. The Fameuse trees were slightly larger than the McIntosh.

In the checks made there were no significant differences in the size of the fruits produced on the different stocks. All were of very good size for the variety.

McIntosh on Beautiful Arcade produced somewhat larger apples than the remainder, and No. II somewhat smaller. Fameuse, No. IX, gave the largest apples. The experiment is still in progress and further changes in the relative position of the various stocks are expected.

The colour was good with all types, and none could be seriously held in fault in this particular.

TABLE 9. THE USE OF VEGETATIVELY-PROPAGATED ROOT-STOCKS FOR APPLE-TREE PROPAGATION: AVERAGE YEARLY YIELDS PER TREE

Variety	Number of trees	1938	1939	1940	1941	1942	1943	1944	1945	1946	Total
		lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Fameuse											
Malling I	16	1.3	5.0	12.6	21.3	3.9	146.6	2.5	161.2	28.8	383.2
Malling II	16	2.3	4.1	22.0	34.0	19.7	167.7	17.1	179.7	22.8	469.4
Malling IX	12	5.8	6.9	15.1	6.2	12.2	67.9	14.9	45.8	22.4	197.2
Malling XII	16	0.9	1.9	0.1	5.4	0.4	120.2	43.0	147.2	23.2	342.3
Anis	15	1.8	1.6	3.7	15.5	4.2	166.3	7.5	154.5	12.3	367.4
Beautiful Arcade	16	0.9	1.7	5.8	16.4	6.5	182.6	2.8	186.6	21.4	424.7
McIntosh											
Malling I	16	8.1	10.9	24.4	11.7	33.2	111.1	138.4	163.4	63.4	564.6
Malling II	16	10.1	12.9	22.8	10.8	26.4	88.2	122.4	134.1	50.3	478.0
Malling IX	14	18.1	8.1	16.0	10.6	18.4	52.1	47.6	27.3	51.1	249.3
Malling XII	16	1.9	10.1	25.4	13.6	17.1	87.6	161.4	94.5	155.8	567.4
Anis	16	8.0	14.3	26.2	15.5	24.7	96.8	174.7	135.3	131.7	627.2
Beautiful Arcade	16	17.4	25.7	36.8	28.5	42.6	163.1	207.9	152.3	133.4	807.7

Hormone Sprays to Control Pre-harvest Drop

(R. P. Longley)

The aims in apple production in the Annapolis-Cornwallis Valley are constantly changing. Colour and high dessert quality were relatively unimportant in producing cooking apples for the United Kingdom, but the rapid increase in demand for dessert or general-purpose apples has directed more attention to red colour.

The present requirement as this report is written, is for large, red, general-purpose apples of high quality. Several methods are employed to meet this need. Red sports are being used to secure colour; new varieties are being sought; and careful pruning and thinning are assisting in getting better size and more colour. Possibly no practice has contributed more to lowering the general quality of the apples of the district than early pickings. The grading regulations have not stressed proper maturity as much as blemishes and colour. It is granted that individual growers may temporarily gain by early picking, as natural dropping and wind and frost damage are sometimes avoided. On the other hand, the reputation of the entire fruit crop suffers, as immature apples are of distinctly less value than those that are well matured on the tree. In the end, the industry as a whole sustains a heavy loss from the far too common practice of premature picking.

It is well known that during the period over which a variety is harvested both colour and size of fruit improve materially.

Tests at the Station show that apples of certain varieties increased in size by 36 per cent during the period from the first picking in the Annapolis Valley until the variety was at the proper stage of maturity for harvesting. The change in colour over the same period was equally as striking.

Tests of chemicals designed to hold the apples on the trees and so minimize the loss from dropping were conducted on Gravenstein and McIntosh in 1940, 1942, 1943 and 1944. In 1940, naphthalene acetic acid was used on Gravenstein at a concentration of 4.8 grams per 100 gallons of water in both one and two applications. On McIntosh it was used at concentrations of 2.4, 4.8 and 9.6 grams per 100 gallons in one application, and also at 4.8 grams per 100 gallons in two applications.

Fig. 3—Applying Hormone Spray at Experimental Station, Kentville, N.S.

These tests demonstrated the value of the sprays and indicated clearly that they are effective. They showed that where apples are to be held on the trees until they are distinctly past their proper maturity two sprays about ten days apart are needed.

Commercial preparations were used in 1942, 1943 and 1944. The test on Gravenstein in 1942 was with Parmone and Phyomone, at a concentration of .001 per cent. They gave very nearly equal results. The drops amounted to approximately 25 per cent of those from the check trees.

The test on McIntosh was more extensive. The same materials were used at the same concentrations in both one and two applications; there was also one application of a double-strength solution. The trees which received a single application of single-strength spray were picked on September 30. The drops were comparatively light, amounting to the following: Parmone, 2.7 per cent; Phyomone, 3.1 per cent; check, 4.2 per cent. The others were picked on October 13. The drops amounted to the following: Parmone .001 per cent concentration, two applications, 5.1 per cent drops; .002 per cent, one application, 3.7 per cent drops; Phyomone .001 per cent concentration, two applications, 3.9 per cent of drops; .002 per cent concentration, one application, 2.0 per cent of drops; check, 12.5 per cent of drops.

The results in 1943 were of no value because of heavy winds which caused the amount of drops to total up to 89 per cent on some plots.

In 1944 Parmone, Stafast and Phyomone "B" were used at 10 parts per million in two applications, and 20 parts per million in one application, on McIntosh, and Stafast and Phyomone at standard strength (10 parts per million of naphthalene acetic acid) on Gravenstein. The results on Gravenstein were better with Phyomone than with Stafast. The percentages of drops recorded were: Phyomone, 8.07; Stafast, 16.5; and no treatment, 20.67. The percentage of drops with the various sprays on McIntosh were, with a concentration of 10 parts per million, two applications: Parmone, 1.95 per cent; Stafast, 4.21 per cent; Phyomone "B", 16.97 per cent. The double-strength application (20 p.p.m.) with one spray gave drops as follows: Parmone, 4.30 per cent; Stafast, 11.61 per cent; Phyomone "B", 8.29 per cent; check, 12.78 per cent.

The most effective treatment was that obtained by spraying with two standard-strength applications of Parmone. Stafast showed better on McIntosh than on Gravenstein, and the standard-strength applications of the new naphthoxyacetic acid-containing Phyomone "B" show, if anything, an increase of drops over the water-sprayed controls.

In the 1942 pre-harvest spray trials, where Parmone and Phyomone were used, it was found, under the conditions of that experiment, that one double-strength application applied to McIntosh apples was more effective in controlling pre-harvest drop than the two standard-strength applications recommended by the manufacturers of commercial hormone preparations. The 1944 results at Kentville did not bear this out, the slight difference between one double-strength application and two standard-strength applications being in favour of the latter.

Soil Deficiencies

(R. P. Longley)

It is considered that this district has been fortunate in the near absence of symptoms indicating soil deficiencies. Orchards which receive no nitrogen show the characteristic light colour of nitrogen deficiency. Potash deficiency is not unknown in potatoes in neighbouring areas, and phosphate applications on potatoes give a response similar in degree to that which is associated with nitrogen applications. In orchards, no phosphate or potash deficiencies have been detected, even when fertilizers supplying only nitrogen have been used for a period of years. It is possible that the keeping quality of apples produced on orchards which have received only nitrogenous fertilizers is inferior to that from orchards receiving complete fertilizers.

Orchards suspected of showing magnesium deficiencies have been observed. These were located on light soils. Due to the possibility that magnesium deficiency may appear more widely, recommendations of limestone applications for orchards have stressed the advisability of using the dolomitic form.

Boron deficiency is general in turnips grown in the Annapolis Valley and shows occasionally in mangels. The orchard fertilizer plots at the Station on the high-lime and slag fertilizer plots for years showed drought spot and corky core, both indications of a lack of boron. Drought spot has been observed in a few other orchards on McIntosh. Corky core has been quite widespread some years. These disorders occurred on practically all soil types, particularly when rainfall was low. Cortland, McIntosh and Gravenstein have been affected most seriously, but the symptoms have also been observed in Fameuse, Gano and Ben Davis.

At the Station, the plots where the trouble was the most serious were sprayed with 2½ pounds of borax per 100 gallons in the pre-pink bordeaux spray, in both 1942 and 1943. This treatment cleared up the trouble completely and up to 1946 no more corky core was observed.

In 1941 an orchard at Waterville which had corky core in 1939 and 1940 was used for a series of experiments. Ground applications of ¼, ½ and 1 pound of borax per tree were used. On other plots 2½ pounds per 100 gallons was added to the calyx application. With the exception of one of thirteen trees which received ¼-pound of borax, all treated trees produced fruit free from corky core. The single tree showed a trace. The crop from the untreated trees all showed corky core, ranging from 60 to 90 per cent.

As an insurance against loss from corky core, most of the trees at the Station have received one or two applications of borax either in the spray, in the fertilizer, or as a separate application.

Frameworking

(R. P. Longley)

The practice of grafting apple trees is much older than the modern commercial industry. Over a long period there was comparatively little advance in the technique. Some growers cut away more branches than others when preparing the trees, some used more stumps and set more scions, some left more limbs to "take the sap" but there were no radical changes in the methods.

It has been recognized that grafted trees do not produce for some years due to their strong vegetative growth. Before 1928, a Tasmanian grower recommended

taking off all twigs, using a much larger number of scions, and using several methods of inserting the scions. This type of grafting was tried at the Kentville Experimental Station and by some growers during the thirties, but no extensive test was made until 1942. This type of grafting, now known as frameworking, aims to reduce the shock to the tree by setting more scions, to secure a better-shaped tree due to reduced vegetative growth, to save more trees from dying, and—of prime importance—to secure crops of apples with less loss of time. Full details of the method are given in the bulletin "Frameworking of Fruit Trees", Dominion Department of Agriculture Publication No. 781.

Experiment 1

Nine large Stark trees set in 1917 were grafted to Crimson Gravenstein in late May, 1942. Three were frameworked with scions set at eight inches apart upon the framework, three trees had scions set at 16 inches apart, and three were top-worked. All four frameworking methods were used indiscriminately on each tree, and scions of six buds in length were used throughout. Careful records were kept of the time required to complete the work on each tree.

Growth on these trees has been measured each year by a sampling method of pruning, but it was found that trunk circumference measurements gave an equally true picture of the treatment effect. Accordingly, the latter record is given below in Tables 10 and 11, together with data on the time required to do the grafting, yield records and the numbers of scions inserted.

TABLE 10. SUMMARY OF RECORDS ON FRAMEWORKING VS. TOP-WORKING EXPERIMENT

(Nine trees (25-year-old Starks) grafted to Crimson Gravenstein in May, 1942. Data as averages of three trees).

Treatment	Time required to graft	Number of scions	Yield per tree		
			1943	1944	1946
	man-hours		lb.	lb.	lb.
8-inch spacing	13.5	640	28.1	487.5	636.7
16-inch spacing	10.7	433	21.9	522.9	623.3
Top-worked	1.3	32	Nil	Nil	Nil

TABLE 11. TRUNK CIRCUMFERENCE OF GRAFTED TREES

Treatment	Spring, 1942	Autumn, 1942	Autumn, 1943	Autumn, 1944	Autumn, 1945
	cm.	cm.	cm.	cm.	cm.
8-inch spacing	117.0	120.1	122.3	124.1	129.3
16-inch spacing	120.0	122.0	124.6	127.3	132.7
Top-worked	109.0	109.9	109.9	111.1	113.3

Tables 10 and 11 show:

(1) After the first two seasons' growth, the closely-spaced scions gave no greater growth or crop than those spaced at 16 inches.

(2) The top-worked trees grew much more slowly, and have borne no fruit to date.

(3) The extra time necessary to place the scions at 8 inches rather than at 16 was not repaid by an increase in fruit.

(4) The amount of fruit borne on the frameworked trees indicates that, compared with top-working, the higher cost of frameworking has been amply repaid.

EXPERIMENT 2

Another test was designed to secure information on the most suitable length of scion, the best method of setting it, and the season when the most satisfactory results could be secured. Twenty Red Stark trees on Malling I and XVI root-stocks, set in the orchards in 1930, were frameworked to Crimson Gravenstein in 1942.

The cleft method was used on twelve trees, four in each of the months of April, May and June. Eight were frameworked by the bark method, four in May and four in June. Each tree had an equal number of long (8-bud) and short (4-bud) scions, and similar numbers of each length were put in by each of the two methods.

In the first two growing seasons (1942 and 1943) complete wood growth measurements were taken, and for the 1944 and 1946 seasons sample growth-measurements were taken. Fruiting was uneven in 1943, and was not recorded. Detailed fruit records were secured from the cleft-grafted trees in 1944.

A storm removed the fruit from the bark-grafted trees in 1944 before records could be taken. There was no crop in 1945, because of the spring frost that destroyed the blossom buds.

The data for wood growth on cleft—and bark-frameworked trees are presented below in Tables 12 and 13. Records for 1942 and 1943 were reduced to a "growth per scion" basis, and for 1944 and 1946 to a "growth per shoot" basis.

TABLE 12. CLEFT METHODS OF FRAMEWORKING: PER CENT "TAKE" OF SCIONS, WOOD GROWTH AND FRUITING

(Red Stark trees frameworked to Crimson Gravenstein in 1942*)

Treatment	Per cent "take," 1942	Wood growth				Fruit, 1944	Fruit, 1946
		Per scion, 1942	Per scion, 1943	Per shoot, 1944	Per shoot, 1946		
	%	cm.	cm.	cm.	cm.	lb.	lb.
April-grafted	97.3	129.7	167.4	19.1	21.4	52.9	242.5
May-grafted	95.6	63.2	119.8	14.2	21.7	20.0	262.5
June-grafted	83.2	19.9	130.7	18.8	25.0	3.6	141.5
Long scions (8-bud)	93.0	78.6	141.4	17.4	.....	27.4	.....
Short scions (4-bud)	91.1	63.4	138.1	17.4	.....	24.4	.....
Stub method	93.4	77.4	150.6	18.6	.....	28.0	.....
Side method	90.7	64.5	128.8	16.2	.....	23.0	.....

*These records are based upon averages of four quarter-tree units for each treatment.

The trees grafted by cleft methods, as shown in Table 12, made excellent growth regardless of the time of grafting, although the April grafting has maintained an early lead. By the third season, the initial differences had nearly disappeared.

In 1946 the growth on the June–frameworked trees was greater than on the April-and May-frameworked trees, but this could be due to the fact that the production was distinctly less.

Long scions made slightly more growth than short scions during the first season, this probably being due to the fact that they carried more growing points to begin with. On a "growth per shoot" basis, by 1944, there was no difference.

Of the cleft methods the stub-grafting method has given consistently more growth than the side grafts. The "take" of scions was low in June because of one tree growing on a very shallow soil. This tree dried out badly during the very dry summer of 1942. Apart from this factor, the "take" of scions was almost uniformly good.

Fruiting was obviously influenced by the time of grafting, trees grafted in April having a much better crop than those done in May or June. In general, the later grafting produced progressively less fruit.

Bark frameworking results are shown in summary in Table 13.

TABLE 13. BARK METHODS OF FRAMEWORKING: PER CENT "TAKE" OF SCIONS AND WOOD GROWTH
(Red Stark trees frameworked to Crimson Gravenstein in 1942*)

Treatment	Per cent "take" 1942	Wood growth				Fruit, 1946
		Per scion, 1942	Per scion, 1943	Per shoot, 1944	Per shoot, 1946	
	%	cm.	cm.	cm.	cm.	lb.
May-grafted	90.4	52.7	232.2	19.1	24.0	46.3
June-grafted	87.8	23.0	200.1	20.4	24.4	17.5
Long scion (8-bud)	91.8	39.7	219.7	21.3	....	....
Short scion (4-bud)	86.5	36.1	212.6	18.3	....	....
Inverted-L method	86.8	38.6	250.1	20.8	....	....
Awl method	91.5	37.2	182.3	18.8	....	....

*These records are based upon averages of four quarter-tree units for each treatment.

The bark-grafted trees made much less growth in the first season than those grafted by cleft methods, but more growth during succeeding seasons. Otherwise, the same general comments offered for Table 12 also apply for Table 13.

Tree Fruits—Variety Trials

(A. T. Burgher)

APPLES

Apple varieties grown at this Station and recommended for commercial plantings in the Annapolis Valley are listed as follows, in order of ripening: Crimson Gravenstein, McIntosh, Cortland, Red King, Wagener, red sports of Delicious, Northern Spy and red sports of Red Rome.

Recommended for home gardens and roadside markets are Red Melba, Early McIntosh, Lodi, Lobo and Golden Delicious.

In addition to the foregoing varieties one hundred other sorts are under test.

Fig. 4—Educational Display of Apple Varieties at Annual Convention of Nova Scotia Fruitgrowers' Association at Kentville, N.S.

CHERRIES

Forty varieties of cherries are under test at Kentville.

The most noteworthy varieties in the sweet group are Seneca, Napoleon, Velvet, Bing and Windsor.

Montmorency is the most popular of the sour colourless-juice varieties, and English Morello the best of the red-juice sorts.

Brassington and Royal Duke are the best of the Dukes.

PEACHES

Varieties recommended for planting in favourable locations in the Annapolis Valley are as follows: June Elberta, Marigold, Fisher, Oriole, Golden Jubilee, Vedette and Valiant.

These recommendations are made on the basis of size, colour and quality of fruit, productivity and tree hardiness.

Thirty other varieties are under test.

PEARS

In the Annapolis Valley Clapp's Favorite and Bartlett continue to be the most desirable canning and dessert varieties. Other preferred varieties are Gorham, Ewart, Seckel, Sheldon, Beurre Bosc, Dana Hovey, Anjou and Covert.

Forty-nine varieties are being tested at the Station.

PLUMS

The plums in the following list are recommended as a succession of varieties for western Nova Scotia and other parts of the province where severe winter temperatures do not prevail: June Blood, Becky Smith, California Blue, Burbank, Peter Golden Gage, Washington, Hall, Stanley and Grand Duke.

For the colder parts of Nova Scotia the following varieties are suggested: Bradshaw, Lombard, Yellow Egg, Reine Claude and Shropshire Damson.

QUINCES

The following quinces have been tested at this Station: Bourgeat, Champion, Meech Prolific, Missouri, Mammoth, Orange, Pineapple, Rea Mammoth, Van Dieman. Of these Van Dieman, Pineapple and Orange have been the most satisfactory.

Small Fruits—Variety Trials

(A. T. Burgher)

CURRANTS

Red Currants

Red Lake and Stephen No. 9 are recommended for commercial or home planting.

White Currants

White Dutch and White Grape have been the best varieties at Kentville.

GOOSEBERRIES

For commercial planting and for home gardens, Poorman, Silvia and Clark are considered to be the best sorts. Twenty other sorts are being tested at this Station.

GRAPES

At present twenty-eight varieties of grapes are being tested at the Station.

The most desirable of the black group, tested on the basis of earliness, quality, vine hardiness and fruitfulness are Erie, Van Buren, Athens and Patricia. Of the green varieties the best sorts are Eurle, Ontario and Portland.

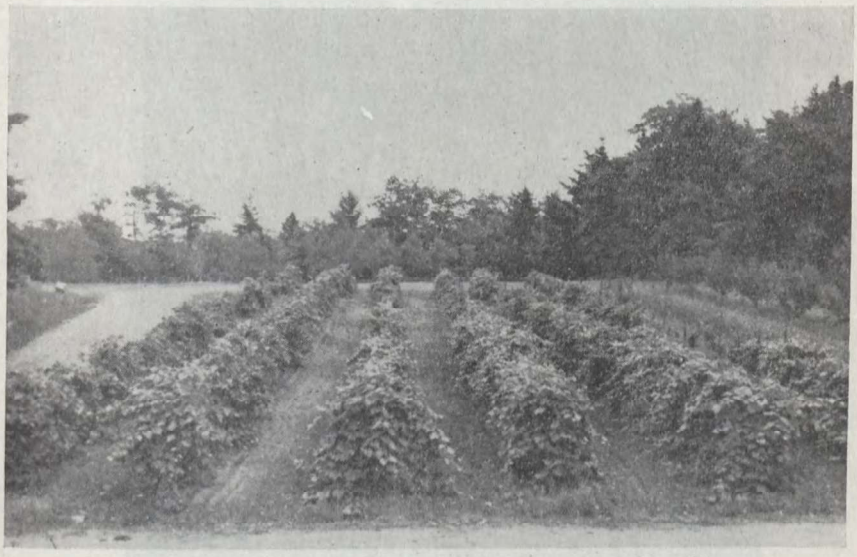

Fig. 5—Vineyard at the Experimental Station, Kentville, N.S.

RASPBERRIES

In the Annapolis Valley the Viking raspberry continues to be the most satisfactory variety from the standpoint of quality, productivity, cane hardiness and resistance to disease.

Newburg, although more resistant to mosaic, does not withstand dry conditions as well as Viking. At Kentville it is rated next to Viking. Rideau is also gaining in popularity. Taylor is considered the best late variety. Latham also is popular with some growers.

BLACKBERRIES

Blackberries have been grown with only limited success at Kentville. Lowden and Eldorado are two of the best varieties.

STRAWBERRIES

In the Annapolis-Cornwallis Valley strawberry-growing districts, Premier and Senator Dunlap continue to be the preferred commercial varieties.

Catskill and Pathfinder are increasing in favour with some growers. McKenzie is the most popular early variety, while considerable interest is being taken in Valentine due to its earliness, appearance and productivity. Although susceptible to leaf spot, Louise continues to be popular as a late variety. Elgin is useful as a pollinator for Louise.

In the western part of the province, Jessie is the best commercial sort, and in the northern and eastern areas Senator Dunlap continues to find favour, while Catskill is being tried.

Fig. 6—Strawberry Variety Test Plots at the Experimental Station, Kentville, N.S.

High-bush Blueberries

(E. L. Eaton)

BLUEBERRY HISTORY AT KENTVILLE

On May 31, 1926, the first high-bush blueberries, 160 in number, were planted at Kentville. Included were the varieties Adams, Cabot, Greenfield, Grover, Harding, Katharine, Pioneer, Rancocas, Rubel, Sam and 1232B. At the end of twenty years most of these original plants, except Cabot, remain in full production. They vary in height from 3 feet for Greenfield to six or seven feet for Grover, Rubel, Adams and Rancocas. They are giving annual yields of from five to twelve quarts per plant.

In 1930 and 1934 several hundred seedlings of high-bush and low-bush parentage were set. The high-bush seedlings were progeny of open-pollinated plants of Rubel, Pioneer, Sam and Harding. The low-bush plants were the result of controlled crosses among a group of native low-bush plants gathered in Quebec and Ontario. There were also a few crosses between high- and low-bush parents. This material was propagated at Ottawa and transferred to Kentville, where soil conditions were believed to be more suitable.

The high-bush seedlings contained a large proportion of plants that produced satisfactory yields of large, attractive berries, but only three were distinctive enough

to receive a name; one other is still under consideration at Kentville. Most of the remainder have been removed. Considerable numbers of cuttings from these seedlings are still on test at outside points and a few are promising because of their vigour. The seedling varieties which have been named are Kengrape, Kenlate and Kenafter.

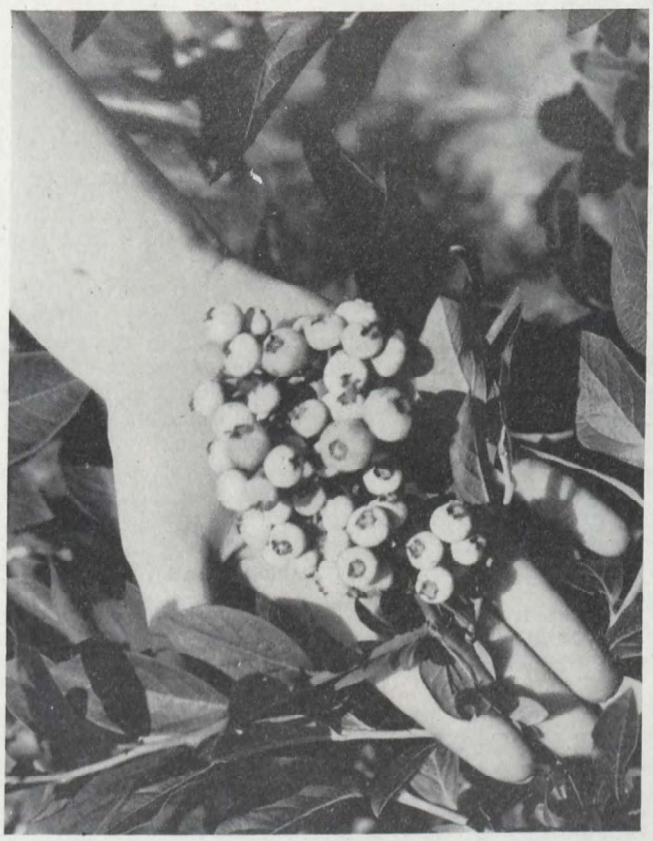

Fig. 7—High-bush Blueberry Cluster, Kentville, N.S.

The Kengrape produces the largest berry of all the varieties tested at Kentville. It is moderately productive and vigorous, forming a low, wide bush which may be adapted to colder regions where winter snow protection is essential.

The Kenlate is an attractive, fine-flavoured berry, but the plant lacks vigour and is not so late as earlier observations suggested.

The Kenafter is of moderate size, vigorous and productive. It has been ripening later than any other variety at Kentville, in some years the green fruit remaining into October. Although named, it is still on the probation list.

The low-bush plants nearly all bore fruit of too dark a colour, a great many being shiny black, and all have been discarded.

Of the crosses between high- and low-bush types, several are superior to the high-bush parent (Sam), and a few are intermediate in type between the two parents, but none are the equal of Jersey or Pioneer, and their commercial value is not apparent.

In 1937 a new plantation, designed to give a more accurate comparison of the named varieties and the more promising seedlings, was added. More recently other varieties have been introduced so that the plantation now includes the following newer varieties: Atlantic, Burlington, Charlotte, Concord, Dixi, Evelyn, Fraser, Jersey, Johnson, Lulu, Pemberton, Richmond, Scammel, Stanley and Weymouth, and the three seedlings Kengrape, Kenlate and Kenafter named at Kentville.

PROPAGATION FROM SEED

A large number of seedlings grown from seed gathered from a native high-bush plant at Maxwelton, Digby county, were set in 1937. These varied greatly in resistance to leaf spot, habit of growth, colour and quality of fruit. Although hardy, none produced fruit of desirable size. A few were used as parents in breeding, the others have been discarded.

Seed has been extracted from most of the good named varieties, and seedlings grown from them. It has been found that blueberry seed, taken from the fresh pulp and sown in a mixture of peat and sand, germinates freely if kept thoroughly damp and carried at a temperature of from 70° to 90°F. More rapid growth is made when the flats are partially filled with fertile garden soil and only the upper portion of the flat filled with peat and sand. Under these favourable conditions the seedlings usually begin to appear in six or eight weeks. Plants in the seedling stage failed to respond to applications of nitrate of soda. Seed sown out-of-doors, both in fall and spring, germinated poorly. Seed that is washed, dried and then sown has always germinated poorly, and treatments with strong and dilute sulphuric and hydrochloric acids, or by scarification, failed to increase germination.

In response to a request from a commercial firm, a series of germination tests was made in 1945. Seed extracted from the fresh fruit, and washed and dried, was supplied by the firm. A part was scarified by rubbing between two sheets of sandpaper. After treatment the seed was washed, and then sown in Petri dishes in equal parts of sand and peat, and carried at room temperature (60° to 70°F.). Table 14 gives the results.

TABLE 14. BLUEBERRY GERMINATION TEST, 1945

Treatment	Per cent germinated	
	Scarified	Unscarified
Conc. sulphuric acid, 5 hrs.	% Destroyed	% Destroyed
" " " 4 days	"	"
10% " " 5 hrs.	12	15
10% " " 4 days	0	0
Conc. hydrochloric acid, 5 hrs.	0	0
" " " 4 days	0	0
10% " " 5 hrs.	14	0
10% " " 4 days	0	0
No treatment	17	30

It will be noted that all the treatments reduced or prevented germination.

During the winters of 1942 to 1945, inclusive, a total of 47 varietal crosses was made in the greenhouse. Pollen was gathered by picking the flowers and rolling them gently between the thumb and finger. For convenience, the pollen was collected in Petri dishes and covered at once to prevent contamination. In the high-bush blueberry flower the stigma extends beyond the corolla and it is a simple matter to apply the pollen, previously collected, with the tip of the little finger. Seedlings from these crosses are being grown and studied. The first fruit appeared in 1946.

PROPAGATION FROM CUTTINGS

Since the blueberry seedlings differ from and are usually poorer than the parents, vegetative propagation is followed commercially. The standard method has been to take cuttings from the new growth, discard the tip portion carrying fruit buds, and cut the remainder into suitable pieces. These are placed in granulated peat under glass and shade, with just enough ventilation to check moulds. Both hardwood and greenwood cuttings have been used.

Hardwood cuttings are taken any time in the dormant season and are packed in green sawdust, or old sawdust with about the same moisture content. The cuttings are made about four inches long, the lower cut being just below a bud and the upper cut just above a bud. They may be set in the frames as soon as severe frosts are over.

Greenwood cuttings are taken from the shoots of the current year, just before secondary growth begins. At Kentville this is usually around mid-July. All the leaves are removed except two at the tip; otherwise the cuttings are treated the same as those taken in the winter.

Of the older varieties, Rancocas has been one of the easiest to root and Katharine one of the most difficult.

In 1939 a comparison was made of naphthylene acetic acid, and indolebutyric acid, each with talc, with charcoal, and in water solution; at rates varying from 50 to 1000 parts per million. A commercial preparation, Hormodin A, was also used at rates from 10 to 80 parts per million.

The dusts were applied by dipping the cuttings to a depth of one-half inch and shaking the material off. Where liquids were used, the base of the cutting was immersed for 24 hours.

Dusts with the talc base checked rooting. Good rooting was obtained with the charcoal base. Liquid treatments of 10 and 20 p.p.m. gave definite rooting response. Above 20 p.p.m. the results were variable, with browning of the tissues at the base of the stem indicating injury. The optimum seems to be 10 p.p.m. which permits a fair margin of safety.

Little benefit was found from the use of hormones on dormant cuttings, but rooting was definitely stimulated in the greenwood cuttings, with the effects much more evident in those varieties that are normally more difficult to root.

SOIL MANAGEMENT

The original planting at Kentville was on moderately heavy land which was wet in spring and dry in summer. The plants were heaved badly each year by frost. Fruit size and fruit yields were low. In 1938 several plots were laid out, in which mulches of sawdust, peat, straw and hay were compared with clean cultivation. The sawdust plots were the most satisfactory, with growth and yields of fruit much better than on any of the other treatments. In the fall of 1940 most of the plantation received a layer of three inches of mill sawdust. Clean cultivation was followed as weeds appeared, and couch grass was practically cleared out in one season. Adjoining sections, set in 1937, were under sod and clean cultivation; the latter made much the stronger growth. When sawdust was spread on the sod and cultivated in, the plants in that section overtook those under clean cultivation without sawdust in two years, and at the end of four years were double the size of those that had been cultivated from the beginning of the test.

In 1946 soil samples were taken from the sawdust area and tested by a Science Service chemist for acidity, moisture-holding capacity and organic matter. The sawdust had made little difference in the acidity, but it had greatly increased the moisture-holding capacity, and a fair amount of the sawdust was still present in the soil.

The readiness of blueberry stems to root when banked with sawdust is noteworthy. This material is a more favourable medium than peat where layering is practised.

Land for blueberry seedlings was partially prepared in the summer of 1944, and covered with sawdust during the winter. A backward spring in 1945 prevented early cultivation and weeds had started freely, so before the plants were set the sawdust was

thoroughly harrowed into the soil. Hot dry weather followed the setting of the tiny plants and many died, but the survivors have made particularly good growth. This suggests that sawdust is a valuable amendment when mixed with the soil, and plans are being made to compare sawdust mulch with sawdust worked into the soil.

Winter-killing of the Grover variety, set in 1926, was severe most years until 1944. In many seasons the entire crop was lost through the dying back of the twigs which would normally carry the new bloom. In 1944 another method of management was started in which clean cultivation was practised until late July, and annual weeds were then encouraged to grow as a cover crop. Under this treatment the new wood has hardened off more thoroughly and no winter-killing has occurred since.

FERTILIZER

No stable manure has been used since the plantation was started. In the early years a special mixture containing some organic material was used. Later a 4-8-7, home-mixed fertilizer was substituted. It was believed that a higher rate of nitrogen was desirable and 9-5-7, factory-mixed, is now in use. Applications have been made by hand in the area near the plants where most of the fine roots are found. Mature plants receive about one pound each and smaller ones proportionately less. The material is applied in early spring, before the buds burst, as the new growth is easily injured if it comes in contact with the fertilizer. Stronger new growth has been noted under the 9-5-7 treatment.

MARKETS

In the years 1944, 1945 and 1946 consumer demand for this new fruit was tested. Berries were packed in pint containers covered with cellophane, and placed on sale through chain and independent stores at consuming centres. The price was set by the Station and unsold berries were returned. The general buying public seems willing to pay as much for a pint of these as for a quart of wild berries when offered at the same time. There is a limited demand at a higher price when native berries and other fruits are lacking. Shipments have been sent as far as Toronto and Ottawa by common carrier and have arrived firm enough to be saleable for several days.

YIELDS

Annual crops have been produced since a satisfactory way of management has been found. Regular pruning, to remove the older twigs, stimulates new growth, which in turn carries larger berries. The growth of the plants is reflected in the yields each year.

At Kentville, picking usually begins the last of July and finishes in early September. Picking on alternate days was followed in the early years but resulted in a product which lacked flavour. Picking is now done once a week and the flavour is excellent, with no loss in keeping or handling quality. Ten-year-old plants are giving from 4 to 6 quarts each, with older plants occasionally giving twice that quantity. The following yields, shown in Table 15, were secured from substantially the same plants for the past six years of the period under review.

TABLE 15. BLUEBERRY YIELDS AT KENTVILLE

Year	Yield in quarts
1941	218
1942	507
1943	462
1944	767
1945	844
1946	1588

CONCLUSIONS

High-bush blueberries are hardy at Kentville, where semi-tender apples such as Cox Orange, Baldwin and Spy are grown. Their ability to survive beyond this climatic range is yet to be demonstrated.

Under proper cultural methods, the high-bush blueberry gives heavy annual crops that compare favourably with the yields obtained elsewhere.

The fruit is attractive, and is readily sold. Individual varieties possess more distinctive flavours than the wild blueberries.

The high-bush blueberry remains on the bushes longer and holds its flavour and appearance during shipment better than any other of the common small fruits.

Fertile, well drained soils that are fairly acid in reaction (technically, with a pH value ranging from 4.60 to 5.?7), to which three inches of mill sawdust have been added, have proved suitable for high-bush blueberries. Poorly drained land that dries slowly in the spring is not desirable.

CRANBERRIES

(E. L. Eaton)

The bog soil commonly used for cranberries is lacking on the Station and, with one exception, work on this crop has been of necessity conducted elsewhere.

DRY-LAND PLANTATION

Since wild cranberries are occasionally found on poorly drained areas of dyke land, a small corner of the Experimental Station dyke land was ploughed, graded, sanded and planted in 1939. This site was on the type of soil known locally as "hard red dyke", recognized as excellent for timothy and clover, fair for oats and barley, but too compact and hard for cultivated crops. The vines for the purpose were gathered from a natural cranberry bed on the damp inshore dyke at Upper Clements, Annapolis county. A large proportion of replacements were necessary, and vines from the same source were secured again in 1940. Again, there were many losses nad gradually the remaining plants died, the project being finally abandoned in 1944.

BOG-LAND PLANTATION

In 1941 an acre of bog land was leased at Aylesford for the study of cranberries. This is a deep, black muck soil, part of a large cranberry development. The land was turfed, graded, ditched and sanded ready for planting. A large reservoir provides water for irrigation and frost protection. One-third of the area was set aside for the study of desirable wild selections and seedlings, the first of which were set in 1941, in individual hills four feet apart each way. These have since been trained into compact hills or beds, about three feet in diameter, with paths between. The remainder of the land was set in 1942 to vines of Early Black and Howes, imported from Massachusetts.

This leased land is bordered on one side by a section planted by the owner in 1942 with native vines, and on the other side by similar vines set about 1939. A well defined ditch separates the former, while a double ditch and dyke forms a barrier next the latter.

A total of 442 cuttings and 61 seedlings have been set in the portion assigned to individual plant study. Several of these cuttings are known to be replicates, but 18 distinct sources of material in the three Maritime Provinces have been drawn on and a wide range in type and quality is already apparent.

Comparative yields have been taken from the Early Black, Howes and the adjoining plantation. As the clonal and seedling selections come into fruit, samples are being selected for study of yield, appearance, size, flavour, keeping and culinary quality.

Neither the named varieties nor the natives are in full production, and conclusions are therefore premature. It is apparent, however, that the Early Black is at least a week earlier than the Howes or those grown commercially in the district. The colour and flavour which go with this earlier maturity are quickly and favourably noted by the few consumers who have sampled the fruit. One native selection gives promise of being significantly earlier and larger than the Early Black and equally as attractive.

Yields from ten random samples in 1946, computed on an acre basis, show Early Black, 640 pounds; Howes, 415 pounds, and natives, 640 pounds. The Early Black and Howes plantings are fairly comparable. The natives, although planted the same year, were set much closer and for that reason are giving larger yields than if they had been spaced more widely. The new uprights and runners, indicative of the prospective crop in the near future, are much more numerous on the Early Black than on either the Howes or the natives, and field notes at present are distinctly favourable to this variety.

A light application of sand, averaging about one-half inch in depth, was applied on the ice during the winter of 1946, the first re-sanding since the bog was established.

Elderberries

(E. L. Eaton)

The dark or purple-fruited elderberry, *Sambucus Canadensis* L., is widely distributed throughout eastern Canada and northeastern United States. The fruit is highly prized in many localities for domestic use, blending particularly well with apple products, to which it lends colour, flavour and vitamins. Tests at Kentville have shown that the plants may be quickly and cheaply propagated, come into fruiting early and yield heavily. Large numbers of seedlings are compared. A commercial test of the product is being made by a processor with fruit grown under contract on five different soil types in the Annapolis Valley, the plants for which are being supplied by the Experimental Station.

Fig. 8—Elderberry Seedling Block Three Years Old, Experimental Station, Kentville, N.S.

VEGETABLES

(E. W. Chipman)

INTRODUCTION

During the period covered by this report, the principal work carried on with vegetables has been variety testing. Many new varieties considered to be worthy of trial have been tested beside the old standard ones, which serve as a basis of comparison. Through these trials the most suitable varieties have been selected and are recommended in this report.

Many cultural experiments have also been carried out to determine the methods to be employed to obtain maximum yields, and to aid the vegetable grower.

Because of the particular interest shown in tomato culture, a nutritional experiment was carried out in 1946 to determine the fertilizer requirements of this vegetable.

During the war years, there was considerable expansion in commercial vegetable canning, with peas being the principal crop. Because of this general interest, experimental work to determine the nutritional and pH value requirements of soils for pea culture has been carried out. The effect of inoculating seed was also studied, along with variety testing.

These trials have been carried out on a well drained sandy loam area. Stable manure at rates of 10 to 15 tons per acre, supplemented with a broadcast application of from 800 to 2000 pounds of 4-12-6 fertilizer mixture per acre, was applied yearly. The land was used continuously from year to year and a system of rotation was followed to avoid the planting of the same crop on a specific area in successive years.

The experimental garden serves as a practical demonstration to interested visitors.

Fig. 9—The Vegetable Garden, Experimental Station, Kentville, N.S.

ASPARAGUS

Mary Washington in experimental trials has proved to be a very satisfactory variety. At time of writing Donald Elmira seedling and Eden No. 54 (C.E.F.) are under test.

In 1925 two experiments were started with the object of determining from a yield standpoint, first, the distance apart to set plants in rows, and second, if one- or two-year-old plants are better for transplanting to the permanent bed or trench.

TABLE 16. ASPARAGUS, DIFFERENT DISTANCES OF PLANTING: ONE- AND TWO-YEAR-OLD PLANTS

SEED SOWN IN GREENHOUSE APRIL, 1925; TRANSPLANTED MAY, 1925

Length of row	Distance apart in row	1928-1944	
		Yield of tips	Weight of tips
ft.	ft.	No.	lb. oz.
66	1½	5927	147 8
66	2	5870	145 2
66	2½	5036	107 14
66	3	4097	96 14
Transplanted in trench, 1927 (2-year-old plants)			
66	1½	7758	203 4
66	2	7523	177 2
66	2½	6053	144 10
66	3	4649	111 4

From Table 16 it is clearly indicated that higher yields were obtained from the 1½-foot spacing and from plants two years old at the time of setting out.

BEANS

Snap Beans

Thirty-six varieties were tested. Masterpiece and Dwarf Sugar are recommended as green varieties, and Round Pod Kidney Wax and Pencil Pod Black Wax as wax kinds.

Fig. 10—Bean Variety Test, Experimental Station, Kentville, N.S.

Pole Beans

Thirteen varieties were tested. Scarlet Runner and Kentucky Wonder Wax are recommended.

Broad Beans

Sharpe Conqueror is recommended as the best of the five varieties tested.

Soybeans

Early Black Eye and Early (0.1497) have been tested, and the former has proved suitable for this locality.

Shell Beans

A great many varieties of field beans have been tested with the object of getting maximum yields with good baking qualities. Navy, Michelite and Kenearly Yellow Eye (a pure-line selection made from Yellow Eye at the Experimental Station, Kentville; a good yielder and of high quality) are considered the most suitable.

BEETS

Fourteen varieties were tested, and the following are recommended: Detroit Dark Red, Asgrow Canner and Crosby Egyptian.

Cultural Tests

Each year the varieties under test have been planted on two different dates, to determine the best time to show for this locality. From these tests it was found that where early beets are desired, an April sowing may be made, but for storage purposes an early June sowing is most suitable.

CABBAGE

Fifteen varieties were tested, and the following are recommended: Golden Acre, Copenhagen Market, Penn State Ballhead and Danish Ballhead.

Danish Stonehead is considered the best red cabbage, and Savoy Chieftain the best Savoy cabbage.

Three varieties of Chinese cabbage have been grown: Wong Bok, Pe Tsai and Chihli. All are suitable for the local climate but must not be sown until the first week in July, and in some places even later, because if sown early they will bolt.

Cabbage Culture

Each year the varieties under test have been planted on two different dates: in the greenhouse in March, and directly to the field in May. The object of this experiment is to determine the best time to sow or plant for this locality.

With the early-maturing varieties the heavier yields are obtained from seed sown directly to the field in May, but of course the early planting (greenhouse-sown) will yield earlier heads. With the late varieties the greenhouse plants gave slightly heavier yields. In comparing the two methods the additional costs from greenhouse-grown plants should be considered.

Brussels Sprouts

Of the seven varieties of Brussels Sprouts tested the variety Long Island Improved is recommended.

KALE

Six varieties have been tested, and Dwarf Curled is recommended.

BROCCOLI

Of the three varieties tested Italian Green Sprouting is the only one which has been successful at this Station.

KOHL RABI

Both Purple Vienna and White Vienna did well and are suitable for this locality.

CAULIFLOWER

Thirteen varieties of cauliflower have been tested with the object of finding a high-yielding, uniform-heading variety. Great variability in performance was noted from year to year, making it difficult to pick the best varieties. However, Early Snowball and Early Erfurt may be considered suitable for this locality.

Cauliflower Culture

The varieties under test were planted on three different dates: in the greenhouse in March, directly to the field in May, and then later in June. The object of this experiment was to determine the best time to sow cauliflower for this locality.

The results are somewhat confusing due to the variability in amount and time of rainfall from year to year. However, in most years the greenhouse-sown plants have given the best results. The May sowing has produced satisfactory heads. With late sowing, very poor results have been obtained, making it inadvisable to plant in June.

CARROTS

Of the twenty varieties tested Red-cored Chantenay, Danvers Half-long, and Nantes Half-long are recommended.

Carrot Storage

An experiment to determine the storage qualities of the different varieties was carried out in five different years. Roots of each variety were placed in storage in the fall, and records on keeping qualities taken until May of the following year.

Great differences in the keeping quality of the same variety were noted from year to year, indicating that the choice of variety has litle, if any, bearing on keeping quality. It may be concluded that where seed or soil are infected with the rot organisms no variety will escape.

CELERY

Variety testing of celery for quality and yield has been carried on. Of sixteen varieties grown, Golden Self-blanching and Golden Plume are recommended.

CORN

Fifty-five varieties of corn (twenty-six hybrid and twenty-nine open-pollinated) have been tested for all-round performance, season, general appearance of cob, and quality.

Of the hybrids, Seneca 60, Spancross and Marcross are recommended.

Of the open-pollinated varieties, Golden Sunshine, Golden Bantam, and Bantam Evergreen are considered the most satisfactory.

CUCUMBERS

Of the eleven varieties of table cucumbers tested Early Fortune, A and C, and Straight Eight are recommended.

Seven varieties of pickling cucumbers have been tested, and National Pickling and Snow Pickling have been found the most satisfactory.

EGGPLANT

Of the seven varieties of eggplant tested New Hampshire, New Hampshire Hybrid and Black Beauty are recommended.

HERBS

The following have been grown, and all have done well: dandelion, dill, flowering fennel, horse-radish, lavender, parsley, peppermint, sage, sweet basil, sweet marjoram, summer savory and thyme.

Summer Savory (Harvesting Experiment)

As a test for yield and quality, summer savory was harvested on different dates. Table 17 shows that the best quality was obtained when harvested after 83 days. Yield increased with length of season. Six different lots were sown on May 20, and these flowered on August 14.

TABLE 17. SUMMER SAVORY, 1942

Lot number	Days to harvesting	Yield per acre, green	Yield per acre, dry	Order of quality
		lb.	lb.	
1	80	8,400	720	3rd
2	83	9,840	1,230	1st
3	91	11,337	1,515	2nd
4	98	16,800	1,950	5th
5	106	14,160	2,790	4th
6	112	17,400	3,000	6th

LETTUCE

Twenty-seven varieties of lettuce have been tested, and the following are recommended: Grand Rapids, New York No. 12 or Wonderful, Iceberg, and Bibb.

Dates of Planting

Each year the varieties under test have been planted on different dates. Seeding in the greenhouse to be transplanted is compared with direct field sowings, to determine the dates to seed for a successful crop. Conclusions from these experiments show that for early heads the plants should be started in the greenhouse around March 20 and transplanted to the field the first week of May. These early heads mature well and give a successful crop.

With the field-sown seed the results vary according to the season, but it may be safely stated that the best yields, with quality, are obtained from seed sown during the month of May, and preferably the first of the month. When sown at this time some varieties produce larger heads than the greenhouse plants. June-sown seed brings the heading of the lettuce into the hot dry weather which is detrimental to lettuce culture.

MELONS

Fourteen varieties of watermelon have been tested in an attempt to find an early variety which will give yield with quality. Sweet Sensation and Northern Sweet are considered the most suitable for this area.

Twenty-three varieites of muskmelon have been tested. Golden Champlain and Honey Rock have been found the most satisfactory.

Three varieties of citron have been grown, and of these Red-seeded has been found the most suitable.

ONIONS

Twenty-three varieties of onions were tested with the object of finding an early-maturing variety which would be a heavy yielder of marketable bulbs. The following list includes the ones most suitable.

Fig. 11—Onions in Flower at the Experimental Station, Kentville, N.S

Early Varieties (producing marketable bulbs from fieldsown seed): Early Yellow Globe, Extra Early Flat Red, Portugal, Mountain Danvers and Kenearly. The latter variety originated at the Station from a selection of Early Flat Red. It has done particularly well here. It is an extra early, flat yellow onion, producing bulbs of average size and good keeping qualities.

Main-crop Varieties (producing marketable bulbs from greenhouse transplants): Cranston Excelsior, Southport Yellow Globe, Yellow Globe Danvers, Ebenezer, Southport Red Globe and Southport White Globe.

Dates of Sowing

Each year the onions have been started in the greenhouse on different dates and again sown directly to the field in early May to determine the time to seed for a successful crop.

With the exception of the early maturing varieties and White Barletta, the seed should be sown by March 20 in the greenhouse and later transplanted to the field. However, during an extremely favourable growing season with late fall frosts, seed sown directly to the field may produce mature marketable bulbs. With the early-maturing varieties an early May sowing is generally satisfactory.

Best Size of Set

Experiments have been carried out to determine the best size of set to plant for maximum yield. The results are shown in Table 18 and indicate that the ½- to ¾-inch size is probably the most suitable for maximum yield of marketable onions, with very little seeding or double bulbs.

TABLE 18. ONIONS, BEST SIZE OF SET TO PLANT

Size of sets planted	Per cent plants seeded		Marketable bulbs		Unmarketable bulbs		Number bulbs over 2½ ins. diameter	Number double from 66 sets
	July 31	Aug. 6	Number	Weight	Number	Weight		
	%	%		lb. oz.		lb. oz.		
½" and less	0.0	0.0	33	6 0	0	0 0	11	0
½" to ¾"	10.6	10.6	32	7 10	0	0 0	18	0
¾" to 1"	42.4	42.4	44	6 14	0	0 0	6	14
1" to 1¼"	85.4	85.4	43	8 2	7	0 8	6	37

Multipliers

For five years different-sized sets have been planted to determine the most suitable size for yields of marketable bulbs.

Table 19 illustrates the average results obtained over the five-year period.

TABLE 19. MULTIPLIER ONIONS: BEST SIZE TO PLANT

Size planted	Number Seeded	Marketable		Unmarketable		
		Number	Weight	Number	Weight	Size
			lb. oz.		lb. oz.	in.
½" to ¾"	0	163	12 8	15	0 4	2¼
¾" to 1"	1	198	12 0	41	0 8	1⅞
1" to 1½"	4	288	9 8	146	1 10	1½

It will be noticed that the smaller the set planted out, the larger, but fewer, bulbs of marketable size were produced. The larger sets gave smaller bulbs, a greater proportion of which were unmarketable. The larger sets also showed a tendency to go to seed.

Sets less than ½- inch are not suitable to plant out; ¾- to 1 inch in diameter appears to be the best size.

Shallots

In 1946 a similar experiment was conducted with shallots. The results obtained were the same as with the multipliers. The larger sets gave the greatest number of bulbs, with the smaller ones yielding fewer but larger bulbs.

Leeks

The varieties Elephant and International Prize have been tested and found satisfactory.

Garlic

Two varieties, Pink and White, have been tried at this Station. The white variety was the better of the two but neither did particularly well.

PARSNIPS

Six varieties of parsnips have been tested for yield of marketable roots, and Cooper Champion or Hollow Crown were found the most satisfactory.

Storage

An experiment to determine the storage qualities of the different varieties was carried out on two different occasions. Roots of each variety were placed in storage in the fall and records of quality taken until May of the following year. No significant differences were noted.

PEAS

Eighty-nine varieties of peas have been tested, and the following varieties are recommended, listed in order from early to late: Alaska, Fenland Wonder, Little Marvel, Laxton Progress, Wyoming Wonder, Stratagem, and Alderman or Dark-podded Telephone.

Distance Apart to Sow Fenland Wonder Peas for Canning

In 1938 an experiment was conducted to determine if close sowing would induce a longer space from base to first pod and thus eliminate much waste in pods when the vines were mowed for canning. Rows were spaced 4, 7½, 15 and 30 inches apart. Four inches was too close, causing much rot, but it did increase the distance from base to first pod by 6 inches or more. At 7½ inches, the distance from base to pod was less, causing more waste in pods when mowed. For the 15– and 30–inch distances the pods were very close to the base and severe waste could not be avoided. The yields were heaviest from the close plantings but the largest-size peas were from the 15-inch and 30-inch spacing. The 7½ inch sowing was most satisfactory in preventing the pods from being spaced too near the base; this distance also produced a good crop of high-grade peas.

Pea Culture

In 1946 a lime and inoculation experiment with field peas was carried out. Hydrated lime, ground limestone and slag were applied on an acid soil to determine their effect on the yield of peas.

A comparison was made also of the interaction of inoculated and uninoculated seed with the different lime treatments, and on plots where no lime was applied.

The hydrated lime was applied at the rate of 3000 pounds, and the ground limestone and slag at 4000 pounds, per acre. These three were put on in quarter-acre strips in one direction, and a fourth quarter-acre strip was left untreated.

A 4-12-6 fertilizer was applied at the rate of 500 pounds per acre over the whole area.

Inoculated and uninoculated Perfection pea seed was sown in eight-foot bands (seeder width) at right angles to the lime and non-lime strips.

A record of yields was obtained by hand-picking a square-yard area at random from each plot.

The peas were greatly retarded in growth, especially during the first part of the season, by weeds (spurrey) and the unusually dry weather, and the yields obtained were consequently low for a commercial sowing. On August 7 four areas were hand-picked from each of the different lime and no-lime treatments in the inoculated and uninoculated strips. Since the stand of peas was far from uniform this method does not give as true representation of yield as could be desired; therefore, allowances should be made in studying the yields in the table.

Noting the yields it can readily be seen that the inoculated seed outyielded the uninoculated except on the hydrated-lime plot. In the lime experiment the slag and hydrated lime gave the best results.

In field observations the plots having inoculated seed appeared greener and more vigorous than the non-inoculated. The hydrated lime and slag plots were definitely better than the ground limestone and untreated plots, which appeared about the same.

Although no immediate benefits were derived from the ground limestone it is reasonable to assume, considering the favourable results obtained with hydrated lime and slag, that higher yields could be expected if the lime had been applied well in advance of the crop.

In the light of the results obtained it is evident that lime on these soils is beneficial in the culture of peas. With regard to the inoculation of seed, benefits were obtained on this particular soil, but it cannot be definitely stated, until more experimental work has been carried out, that similar results will be obtained from all soils.

TABLE 20. FIELD PEA CULTURE: LIME AND INOCULATION EXPERIMENT (YIELDS FROM SQUARE-YARD AREAS)

Treatment	Weight of shelled peas										Yield per acre		Number unthreshable pods		Height of vine	
	Jumbo		No. 1		No. 2		No. 3		Total							
	Check	Inoc.	Check	Inoc.	Check	Inoc.	Check	Inoc.	Check	Inoc.	Check	Inoc.	Check	Inoc.	Check	Inoc.
	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.			in.	in.
No treatment	5	11	5¾	5	2¼	2	¼	¼	13¼	18¼	1,002	1,380	6	12	18	19
Ground limestone	6	9¾	5½	5½	1½	2	¼	¼	13¼	17½	1,002	1,323	6	23	18	19
Slag	10¼	14¾	5¼	7½	1½	2¾	¼	¼	17¼	25¼	1,304	1,966	7	24	21	21
Hydrated lime	11	5¾	4¼	5½	1½	3	¼	¾	17	15	1,285	1,134	5	4	19	21

PEPPERS

Peppers have been tested in order to find an early maturing variety which is a prolific bearer of high-quality fruit. Harris Earliest has been the most satisfactory.

PUMPKINS

Six varieties have been tested with a view to finding a marketable pumpkin of high quality. Small Sugar and Winter Luxury are considered to be the best.

RADDISH

Of the twelve varieties of radishes tested Saxa, French Breakfast, and White Icicle are recommended.

RHUBARB

Varieties of rhubarb have been tested with the object of finding a high-quality type of good appearance suitable for this locality. Ruby, Macdonald, Strawberry, and Sunrise are recommended. The latter was selected at the Station from a clump of open-pollinated seedlings of Ruby. It has much thicker stalks, is of high quality, a good cropper and is very satisfactory for forcing.

SALSIFY

Salsify has been grown to determine if it is suitable for this locality. One variety, Sandwich Island has been grown. It does fairly well, but the roots grow rather branching. The seed sometimes does not germinate well.

SPINACH

Fourteen varieties of spinach were tested and the following are recommended: Bloomsdale Longstanding, King of Denmark, and Giant-Leaved Noble.

Other greens which have been tested and found to be suitable for this locality include Swiss Chard and Tampala. The latter needs considerable moisture.

SQUASH

Of eleven varieties of squash tested for quality, marketable size and yield, the following are recommended: Improved Green Hubbard, Golden Hubbard and Buttercup.

Fig. 12—Hotbeds and Cold Frames, Experimental Station, Kentville, N.S.

TOMATOES

Sixty-eight varieties of tomatoes have been tested and the following are recommended: Bounty, Earliana, Harkness, Break of Day, N. Y. State, Globonnie, Super Bonny Best, and John Baer.

Fertilizers for Tomatoes, 1946

Nitrogen, phosphorus and potassium were applied, in the formulae shown in Table 21, at the rate of one ton per acre.

TABLE 21. CHEMICAL FERTILIZER FOR TOMATOES

Plot number	Treatment	Plot number	Treatment	Plot number	Treatment
1	0–5–2½	11	2½–5–5	21	5–5–10
2	0–5–5	12	2½–5–10	22	5–10–2½
3	0–5–10	13	2½–10–2½	23	5–10–5
4	0–10–2½	14	2½–10–5	24	5–10–10
5	0–10–5	15	2½–10–10	25	5–15–2½
6	0–10–10	16	2½–15–2½	26	5–15–5
7	0–15–2½	17	2½–15–5	27	5–15–10
8	0–15–5	18	2½–15–10	28	No treatment
9	0–15–10	19	5–5–2½		
10	2½–5–2½	20	5–5–5		

The chemicals used in producing the desired formulae, given in Table 21, were ammonium nitrate, superphosphate and muriate of potash. These were applied and mixed with the soil before the plants were set. Each plot was 12 feet long and 6 feet wide and two plants were placed in the plot. The area fertilized for each plant would be 36 square feet or 72 square feet per treatment. The distance between plots was 12 feet.

Plots were randomized, and replicated four times. The variety used for this experiment was Earliest and Best, sown April 6 in the greenhouse, and transplanted to the field June 13.

Beginning August 3, the ripe tomatoes were picked weekly until September 27, when all the fruit was gathered. The yields shown in Tables 22 to 27, inclusive, are taken from eight plants.

TABLE 22. FERTILIZERS FOR TOMATOES: AVERAGE YIELDS (TOTAL COUNT) AND WEIGHT OF TOMATOES FOR THREE NITROGEN LEVELS AND THREE PHOSPHORUS LEVELS, 1946

	5 per cent phosphorus		10 per cent phosphorus		15 per cent phosphorus		Average of nitrogen levels	
	Number	Weight	Number	Weight	Number	Weight	Number	Weight
		lb. oz.		lb. oz.		lb. oz.		lb. oz.
No nitrogen	645	123 5	698	139 10	736	146 9	693 (29,729 lb. per acre)	136 8
2½ per cent nitrogen	665	138 2	685	149 11	857	186 4	735 (34,412 lb. per acre)	158 0
5 per cent nitrogen	673	146 14	754	168 7	983	202 11	803 (37,597 lb. per acre)	172 10
Average of phosphorus levels	661 (29,633 lb. per acre)	136 1	712 (33,214 lb. per acre)	152 10	859 (38,849 lb. per acre)	178 6		

TABLE 23. FERTILIZERS FOR TOMATOES: AVERAGE YIELDS (TOTAL COUNT) AND WEIGHT OF TOMATOES FOR THREE NITROGEN LEVELS AND THREE POTASH LEVELS, 1946

	2½ per cent potash		5 per cent potash		10 per cent potash		Average of nitrogen levels	
	Number	Weight	Number	Weight	Number	Weight	Number	Weight
		lb. oz.		lb. oz.		lb. oz.		lb. oz.
No nitrogen	669	134 9	658	130 15	753	143 15	693	136 8
							(29,729 lb. per acre)	
2½ per cent nitrogen	613	135 4	797	174 14	797	163 14	735	158 0
							(34,412 lb. per acre)	
5 per cent nitrogen	782	185 10	763	156 6	864	175 15	803	172 10
							(37,597 lb. per acre)	
Average of potash levels	688	152 7	739	154 1	804	161 4		
	(32,700 lb. per acre)		(33,554 lb. per acre)		(35,119 lb. per acre)			

TABLE 24. FERTILIZERS FOR TOMATOES: AVERAGE YIELDS (TOTAL COUNT) AND WEIGHT OF TOMATOES FOR THREE PHOSPHORUS LEVELS AND THREE POTASH LEVELS, 1946

	5 per cent phosphorus		10 per cent phosphorus		15 per cent phosphorus		Average of potash levels	
	Number	Weight	Number	Weight	Number	Weight	Number	Weight
		lb. oz.		lb. oz.		lb. oz.		lb. oz.
2½ per cent potash	598	139 1	664	145 7	803	170 15	688	152 7
							(32,700 lb. per acre)	
5 per cent potash	656	133 13	714	153 9	849	174 14	739	154 1
							(33,554 lb. per acre)	
10 per cent potash	729	135 5	760	158 13	925	189 10	804	161 4
							(35,119 lb. per acre)	
Average of phosphorus levels	661	136 1	712	152 10	859	178 6		
	(29,633 lb. per acre)		(33,214 lb. per acre)		(38,849 lb. per acre)			

TABLE 25. FERTILIZERS FOR TOMATOES: AVERAGE YIELDS (TOTAL COUNT) AND WEIGHT OF RIPE TOMATOES FOR THREE NITROGEN LEVELS AND THREE PHOSPHORUS LEVELS, 1946

	5 per cent phosphorus		10 per cent phosphorus		15 per cent phosphorus		Average of nitrogen levels	
	Number	Weight	Number	Weight	Number	Weight	Number	Weight
		lb. oz.		lb. oz.		lb. oz.		lb. oz.
No nitrogen	95	27 4	95	30 4	90	30 0	93	29 2
							(6,343 lb. per acre)	
2½ per cent nitrogen	140	41 12	126	41 9	125	40 3	130	41 2
							(8,957 lb. per acre)	
5 per cent nitrogen	121	36 1	157	47 10	175	50 12	151	44 13
							(9,760 lb. per acre)	
Average of phosphorus levels	119	35 0	126	39 13	130	40 5		
	(7,623 lb. per acre)		(8,671 lb. per acre)		(8,779 lb. per acre)			

TABLE 26. FERTILIZERS FOR TOMATOES: AVERAGE YIELDS (TOTAL COUNT) AND WEIGHT OF RIPE TOMATOES FOR THREE NITROGEN LEVELS AND THREE POTASH LEVELS, 1946

	2½ per cent potash		5 per cent potash		10 per cent potash		Average of nitrogen levels	
	Number	Weight	Number	Weight	Number	Weight	Number	Weight
		lb. oz.		lb. oz.		lb. oz.		lb. oz.
No nitrogen	79	25 12	99	30 11	101	31 1	93	29 2
							(6,343 lb. per acre)	
2½ per cent nitrogen	116	38 5	156	48 1	120	37 2	130	41 2
							(8,957 lb. per acre)	
5 per cent nitrogen	139	43 5	142	41 13	173	49 5	151	44 13
							(9,760 lb. per acre)	
Average of potash levels	111	35 12	132	40 3	131	39 2		
	(7,787 lb. per acre)		(8,752 lb. per acre)		(8,521 lb. per acre)			

TABLE 27. FERTILIZERS FOR TOMATOES: AVERAGE YIELDS (TOTAL COUNT) AND WEIGHT OF RIPE TOMATOES FOR THREE PHOSPHORUS LEVELS AND THREE POTASH LEVELS, 1946

	5 per cent phosphorus		10 per cent phosphorus		15 per cent phosphorus		Average of potash levels	
	Number	Weight	Number	Weight	Number	Weight	Number	Weight
		lb. oz.		lb. oz.		lb. oz.		lb. oz.
2½ per cent potash	102	31 14	129	42 10	103	32 13	111 (7,787 lb. per acre)	35 12
5 per cent potash	133	38 13	126	39 6	137	42 7	132 (8,752 lb. per acre)	40 3
10 per cent potash	122	34 6	122	37 7	150	45 11	131 (8,521 lb. per acre)	39 2
Average of phosphorus levels	119 (7,623 lb. per acre)	35 0	126 (8,671 lb. per acre)	39 13	130 (8,779 lb. per acre)	40 5		

The mean rainfall for the three months that the plants were in the field was low. The fruit was slow in ripening, which accounts for the low percentage of ripe fruit. The total yield probably gives the best picture, for during a normal year much more fruit would have ripened.

The acreage yields were obtained by assuming that the eight plants would occupy 200 square feet, or 25 square feet per plant in a commercial planting.

In Tables 22 and 23 there is shown the average yields of all plots receiving 0, 2½ and 5 per cent nitrogen. From the increased yields it is obvious that nitrogen is an important ingredient in the fertilizer mixture.

Tables 22 and 24 show the average yields of all plots receiving 5, 10 and 15 per cent phosphorus. It will be noted that there was a marked increase in yield, particularly with the 15 per cent phosphorus.

Tables 23 and 24 show the average yields of all plots receiving 2½, 5 and 10 per cent potash. The increases in yield are not as significant as those obtained from phosphorus or nitrogen.

Tables 26 and 27 give the average yields of ripe fruit for nitrogen, potash and phosphorus. From these tables it is evident that the increases in nitrogen gave the best results, followed by phosphorus and potash.

From the results of these experiments the practical application is of foremost importance. It is realized that the results pertain to the particular soil under test. However, there is reason to believe that the relationship found may be generally applicable to the fertilizer requirements for tomatoes.

With regard to the level of nitrogen, the largest increase in yield was found in the step from no nitrogen to 2 per cent nitrogen. This probably would vary according to the immediate pre-treatment or condition of the soil. A higher level of nitrogen should not be necessary in soils well supplied with organic material. In sandy soils or others deficient in organic matter a higher level of nitrogen may be desirable.

In connection with phosphorus, the greatest increase in yield was found in the step from 10 per cent to 15 per cent phosphorus. From this it is apparent that a high phosphorus fertilizer is desirable.

With potash, the picture is not so clear, as the increase in yield from 2½ to 10 per cent potash is not significantly great. With ripe fruit (Tables 26 and 27) the greatest increase was obtained in the step from 2½ to 5 per cent potash. Considering the yields of total fruit and ripe fruit it is reasonable to assume that a fertilizer ranging from 5 to 10-per cent potash might be the best.

Of the twenty-seven treatments, the formula 2½-15-5 gave the highest yield.

In the light of this experiment, a suitable fertilizer for tomatoes, selected from present-day commercial preparations, should be, for soils reasonably high in organic matter, a 3-15-6, and for lighter soils a 4-12-6 mixture.

Pruning Experiment

In 1942 an experiment was carried out to compare the early yield of ripe fruit from pruned, and from pruned and staked plants. Yields are calculated on a per-acre basis.

TABLE 28. TOMATO PRUNING EXPERIMENT: YIELD OF RIPE FRUIT PER ACRE

Pruned three stems, 4 ft. by 5 ft.	Pruned five stems, 4 ft. by 5 ft.	Pruned single stem, 1 ft. by 3 ft.	Pruned double stem, 18 in. by 3 ft.
lb.	lb.	lb.	lb.
15,065	13,250	32,065	36,897

It will be noted that the maximum yields were obtained from plants pruned to a double stem, and staked.

TURNIPS

Five varieties of table trunips were tested, of which Early Snowball is recommended.

Swedes

Of the nine varieties of swedes tested Laurentian and Ditmars are recommended.

Fruit and Vegetable Products

(G. W. Hope)

CANNING

Variety Trials

Considerable investigational work has been done on the suitability for canning of varieties of fruits and vegetables grown at the Kentville Station. The following is a resumé of the conclusions drawn:

Strawberries.—Varieties found most suitable on the basis of colour of syrup and product, flavour, and ratio of fruit to syrup include Aroma, Beauty, Blakemore, Bliss, Cato, Clara, Dorsett, George, Marvel and Ralph. Other varieties which have proved acceptable in some of the tests are Aberdeen, Bouquet, Caledonia, Camden, Carl, Cooper, Glen Mary, Horace, Jessie, Jim, Premier, Walter. Florence and Minnehaha have proved unsuitable. Varieties tested and found neither unsuitable nor worthy of recommendation for canning purposes were Bellmar, Culver, Dick, Fairfex, Fruitland, John, King, Thompson, Lemieux, Meighen, Vanguard, William.

The average yield of all tests of all varieties was 108 No. 2 cans (pints) per 100 quarts of berries.

Raspberries.—Six varieties were tested: Adams, Chief, Latham, Lloyd George, Newman No. 23 and Viking. Adams, while showing fair flavour, has not a sufficiently attractive appearance for commercial use, but the other five may be considered suitable for canning.

The yield averaged 17.5 No. 2 cans (pints) per 24-pint crate.

Cherries.—The best red sours were found to be Baldwin, Chase, Morello and Montmorency. The latter, though the recognized canning cherry, was not equal to the other three in quality. The best white sweet cherries were White Caraon and Elton.

Plums.—Of the eighty-one varieties of plums tested, those found most suitable in quality and appearance of fruit and syrup were Belle de Louvain, Burbank, Clymen, De Montfort, Golden Gage, Miller Superb, Ouillens, Reine Claude, Tragedy, Voronish, Washington.

Pears.—Clapp's Favourite was the best of the varieties tested, followed by Beurre Clairgeau. Riehl and Anjou were unsatisfactory.

Beans.—Of the wax beans, Pencil Pod Black, Brittle Wax and Round Pod Kidney Wax gave a product of excellent colour and flavour. Kentucky Wonder had a flavour surpassing all others, but its appearance was poor. Hodson Wax showed little evidence of commercial value as a canning bean. The black pigment of Pencil Pod Black Wax did not cause discolouration of the product if the beans were harvested early enough.

In the green varieties the outstanding bean is the Dwarf Sugar Green. It showed excellent quality and colour. Refugee Green and Stringless Green Pod were found to give a product of good appearance and quality. Bountiful Green is too flat for a canning bean, and Princess d'Artois too stringy.

Peas.—Twenty-six varieties of peas were tested for canning quality. Fenland Wonder and Thomas Laxton were the best canning varieties on the basis of yield and quality of product. Other varieties of good quality were Dwarf Telephone, Foremost, Gradus, Kootenay, Meteor, Reading Wonder, Perfection, Stratagem and World Record. Advancer and Alaska gave very poor results, although they are recognized canning peas in other districts.

DEHYDRATION

Dehydrators.

The physics and mechanics of dehydration were extensively studied in the years just prior to the war and the results of these investigations were published in a bulletin under the title, "Principles and Methods Involved in the Dehydration of Apples", Dominion Department of Agriculture Publication 625, by C. C. Eidt.

Evaporators.

While a large proportion of the Nova Scotia crop is dried in dehydrators, there are many kiln-type evaporators in operation. The efficiency of this type of equipment is improved by the installation of fans and re-circulation ducts, and by using these the drying time for apples can be reduced to 8½ or 9 hours instead of the 13½ to 14½ hours required in the unimproved kiln.

Processing.

Details of drying and pre-drying techniques were worked out for several fruits and vegetables. The following is a brief outline of the investigations.

Rhubarb.—Rhubarb, of the varieties Sunrise, Ruby, Strawberry and Ruby Original, was dried experimentally, the product stored ten months, refreshed, and graded on the appearance and flavour of the cooked product.

All these varieties were found suitable for dehydration. Steam blanching was found to yield a product superior to water blanching, which in turn was more attractive than the unblanched. The correct time in the steam blanch appeared to be about four minutes.

Prunes.—Prunes of the two varieties, Giant and Italian, have been found to grow and crop satisfactorily at Kentville. Batches of these varieties were subjected to a five-second dip in 1.25 per cent lye, and dried in a cabinet dryer for 24 hours. From 568 pounds of Italian, a dry weight of 170 pounds was obtained (a ratio of 1:3.3). From 596 pounds of Giant, there was a dry weight of 119 pounds (a ratio of 1:5).

Consumer reaction to these prunes was obtained by distributing samples, along with a questionnaire. Acceptance of dried Italian prunes was good, 88.9 per cent of the people questioned indicating that they would buy. Dried Giant prunes were not so acceptable, only 66.7 per cent of those queried indicating that they would purchase.

Blueberries.—Blue-ripe, low-bush blueberries gave a satisfactory dried product when dipped 4 seconds in hot 0.2 per cent lye and dehydrated in an Eidt tunnel at temperatures of 175-180°F. primary, and 165°F. secondary. The trays were loaded at 1.33 pounds per square foot.

The refreshing ratio was 1:2.4, the refreshing time was three hours, and the ascorbic acid content was 10.6 mg. per 100 grams of dry fruit.

Beets.—Detroit Dark Red strains were superior to Asgrow Canner. The product obtained by steam blanching beets peeled with an abrasive peeler was superior to that obtained by blanching similarly peeled beets in hot water. No matter which method of blanching was used, abrasive peeling produced a better product than peeling by dipping in hot lye. The best results were obtained by precooking the beets and removing the skins by hand before canning.

The ascorbic acid content followed the same trends as quality and appearance, ranging from 22.7 for precooked and 23.5 for abrasive peel followed by steam blanch, to 19.7 for abrasive peel and water blanch. The stripped beets differed little in quality from the sliced, but had a higher ascorbic acid content (32 vs. 24).

Cabbage.—In all varieties, cabbage without outside leaves and without core made the superior product. Steam blanch was superior to water blanch or sulphite dip, but there was more vitamin C retention where sulphite was used. The order of merit of the varieties tested was: Early Jersey Wakefield, Green Acre, Golden Acre, Erstling, Cannon Ball, Penn State, Danish Ballhead, Ballhead (D. & F. Penn State), Ballhead (Stokes Penn State), Danish Roundhead, Drumhead Savoy and Chieftain Savoy.

Parsnips.—Steam blanchnig was found to be superior to water, and water blanching better than no blanching, in all cases. All American was superior to Short Thick, which in turn gave a better product than Cooper Champion.

Onions.—The varieties Kenearly, Prizetaker, Excelsior, Yellow Danvers, Early Yellow Globe, and Yellow Globe were found satisfactory for dehydration in that order. In some cases a mixture of sliced tops and bulbs was preferable, after drying, to dried sliced bulbs or tops alone. In other cases the latter gave the better product, but in all cases either preparation was quite acceptable.

Unblanched material gave, in all cases, a product superior in quality to either steam or water blanched material, which also tended to discolour during drying and to stick to the trays.

Potatoes.—Extensive experimental work was done on methods of pre-treatment of potatoes for dehydration. On the results of this work were based the procedures recommended to and approved by the British Food Mission for use in Canadian dehydration plants during World War II. While these procedures have since been modified in the light of more recent findings, the fundamentals remain the same.

Carrots.—Of the methods used, steam blanch at 206° to 210°F. for five minutes, was found to give a better product than low-pressure steam and water blanches. The flavour, appearance and texture of the unblanched material were all unsatisfactory. Strips and cubes were both satisfactory.

The varieties used were Touchon, New French Market, Imperator, Chantenay, Red-cored Chantenay, Nantes and Danvers Half-long, of which Nantes and Chantenay are found to be the best.

APPLE RESULPHURING

In the process of drying apples it has been found that, although exposure of peeled and trimmed fruit to sulphur dioxide will prevent discoloration during slicing and drying, the product will become of unattractive colour during subsequent storage. A process of "resulphuring" the dried and cured fruit was accordingly evolved at

this Station. This process consists of permitting the fruit to remain in contact with high concentrations of gaseous sulphur dioxide until the required concentration of the preservative is built up in the tissues.

It was found that resulphured fruit, of 22 per cent moisture and 700 p.p.m. sulphur dioxide, stored satisfactorily. It was further shown that drier fruit required less preservative, and that a general recommendation could be made that storage life would be equivalent to that of the standard provided there was no more than a 70 p.p.m. drop in sulphur dioxide concentration for each 1 per cent drop in moisture.

The interrelation of sulphur dioxide and the moisture content of the rings in the development of discoloration in storage may be observed in the data presented below. Rings dried to five different moisture contents were packed directly in standard 50-pound boxes or 105-ounce plain tin cans, or resulphured 22 minutes and then packed in similar containers. They were placed in three storages: 34°–36°F. cold storage with high humidity; 65°F. and 60 per cent relative humidity; and an apple warehouse where the temperature averaged 70°F. The storage was from March to September. The slices were scored on the basis of 1 representing no colour change to 5 representing dark brown, unsaleable rings. The results are indicated in Table 29.

TABLE 29. APPLE RESULPHURING: DISCOLORATION OF APPLE RINGS OF DIFFERENT SULPHUR DIOXIDE AND MOISTURE CONTENTS

Moisture content	SO_2	Standard box			Plain tin		
		Cold store, 34°–36° F.	65° store	Common, 70° F.	Cold, 34°–36° F.	65° Store	Common, 70° F.
%	p.p.m.						
6.42	284	4	1	3	1	1	1
	290	4	1	3	1	1	1
11.27	157	3	1	4	1	1	1
	325	3	1	3	1	1	1
18.55	141	3	1	3	4	1	3
	571	2	1	2	1	1	2
19.28	206	2	1	3	4	1	3
	587	1	1	2	2	1	1
24.63	87	3	1	5	5	1	5
	863	2	1	2	1	1	1

It will be noted from Table 29 that in the 65° storage, where relative humidities were consistently low (60 per cent), the keep was good in all cases. On the other hand, in storages where the humidity was high the fruit discoloured badly unless protected by resulphuring or by drying to low moisture content and storing in moisture-proof containers.

STORAGE OF DRIED APPLES

Storage Conditions

In order to determine the best method of storing dried apples to preserve the colour and keeping quality of the fruit, a comparison was made in which dried apple rings of different moisture contents were stored in various types of package in different types of storage.

The results of this experiment are conclusive. Material of high moisture content discoloured when exposed to light, even where stored in hermetically sealed

containers. Materials of both high and low moisture content became discoloured when exposed to high temperature in open containers, but such discoloration was less in cellar storage and absent in cold storage.

Material stored in open containers discoloured on the surface regardless of the original moisture content. This discoloration was carried through the material in the low-moisture series and to a lesser extent in the high-moisture series. An explanation of this may be that the high-moisture material was springy and packed tightly whereas the low-moisture material was loose in the containers and consequently more completely exposed to air and light.

Moisture tests made when the material was examined showed an effect of the storage atmosphere upon the moisture content of the apple rings which is thought to explain the differences in keeping quality as measured by the colour score.

Packages

In view of the hygroscopic character of dried apple rings several types of package were tested as containers in which to store this product.

For this experiment, apples of the Ben Davis variety were specially dehydrated in a factory to five moisture contents: 6.42, 11.29, 18.55, 19.28 and 24.63 per cent. These five lots were each halved, one half placed in the containers and the other half resulphured by exposure to the fumes of burning sulphur for 22 minutes before packaging.

Three sets of storage conditions were used: 65°F. and 60 per cent relative humidity; 34°–36°F. and high humidity; and an insulated apple warehouse room in which the temperature averaged 70°. The period of storage extended from March 11 to September 14.

Using the amount of discoloration as a measure of storage quality, the following conclusions were drawn from this work.

1. The unlined box is not a satisfactory container for rings of low-moisture content. For rings at 20 or 25 per cent moisture the package is satisfactory if the rings have been resulphured. Dry storage is necessary to prevent moisture increases, which affect the keep of the material.

2. The use of Fibreen or Pliofilm liners assists in maintaining the moisture content of the material, but does not prevent discoloration of unresulphured rings. Resulphured rings stored better in these lined boxes than in the unlined box.

3. Unlined plain tin cans proved satisfactory containers for low-moisture dried apples but were not satisfactory for high-moisture rings due to the reaction of the fruit and the tin. Waxed-paper liners overcame this objection. The chief disadvantage of this container is the expense—about four cents per pound of dried fruit.

4. While keep was generally better in the aluminium-foil package than in boxes, this container did not entirely prevent the absorption of moisture by the rings of low-moisture content.

5. The few samples (all at 24.31 per cent moisture) placed in Pliofilm bags retained their original moisture, while similar material in open containers in the same room approached 12 per cent moisture. This is taken as a strong indication that this material may have considerable value as liners or as packaging material for resulphured high-moisture material or unresulphured rings of low moisture content.

EFFECT OF SIZE, VARIETY AND MATURITY ON RECOVERY IN APPLE DEHYDRATION

Apples of three sizes and two maturities and in four varieties were compared to determine the effect of these factors upon the cost of production of dehydrated apples. The following tables illustrate these effects; the figures given are averages for size, variety and maturity. Percentage waste and percentage chips are based on 100 pounds of unpeeled fruit. "Pounds per barrel" represents pounds of dried product at 22 per cent moisture per barrel of unpeeled fruit. "Time per barrel"

is the time in minutes taken to peel by means of a Peese machine, and trim by hand (three girls) one barrel of raw fruit. "Ratio" is ratio of pounds of stock at 22 per cent moisture to pounds of peeled and trimmed fruit.

While some of these figures in Table 30 are expressed in terms of single barrels, the fruit was run through the peeling room in lots of fifty barrels each and the average single-barrel data calculated.

TABLE 30. EFFECT OF SIZE ON RECOVERY IN APPLE DEHYDRATION (RIBSTON AND WAGENER)

Size	Chips	Waste	Ratio	Pounds per bbl.	Time per bbl.
in.	%	%		lb.	min.
2–2¼	0.34	47.7	1:6.34	11.22	24.59
2¼–2½	0.31	41.5	1:6.25	13.72	18.42
2½ up	0.29	37.5	1:5.71	14.85	11.05

TABLE 31. EFFECT OF VARIETY (ALL 2¼" UP) ON RECOVERY IN APPLE DEHYDRATION

Variety	Chips	Waste	Pounds per bbl.	Preparation time	
				per bbl.	per lb. stock
	%	%	lb.	min.	min.
Ribston	0.41	39.60	14.79	15.95	1.08
Wagener	0.27	38.45	12.78	15.52	1.21
Baldwin	0.30	38.20	13.92	13.92	1.00
Stark	0.21	39.93	14.91	13.88	0.93

TABLE 32. EFFECT OF MATURITY ON RECOVERY IN APPLE DEHYDRATION (VARIETY, BALDWIN)

Maturity	Chips	Waste	Ratio	Pounds per bbl.	Time per bbl.
	%	%		lb.	min.
Slightly under	0.31	35.93	1:8.76	14.56	13.77
Slightly over	0.30	40.48	1:9.70	13.40	14.23

It will be noted from the above that larger apples give a greater yield of dried stock per barrel of fruit, a lower percentage of chips (pieces passing a ¾" screen), less waste and shorter preparation time. It will be further noted that the difference between the 2¼" apples and the 2½" apples is appreciably greater in all four items than the difference between the 2½" and fruit more than 2½" in diameter. It is also worthy of note that increased yield in the larger sizes is not altogether due to lower proportional waste, as the "ratio" column indicates that one pound of 22 per cent dehydrated apples can be made from 6.34 pounds of peeled, cored and trimmed fruit of the 2–2¼" size, 6.25 pounds of the 2¼–2½", and from only 5.71 pounds of the 2½" up.

Table 31 shows that there may be as much difference in yield as one or two pounds of stock per barrel of apples between one variety and another. This is of interest when one also notes that the wastage is not significantly different. Peeling time varies with variety by as much as two minutes per barrel. On a barrel basis, Ribston takes longer to prepare than Wagener, but on the basis of one pound of product the order is reversed. There appears to be an appreciable difference in preparation time between these two varieties and the other two mentioned, Baldwin and Stark.

The effect of maturity of fruit upon waste, yield and preparation time is illustrated in Table 32. Wastage in the more mature fruit is higher, and the ratio of

prepared fruit to dried product differs by about one pound, giving a difference in yield, on a barrel basis, of 1.16 pounds. Preparation time is also higher for the over-mature than for the under-mature fruit, and is in the relation of 1.11:1 when expressed as dried product.

RELATION OF ATMOSPHERIC HUMIDITY TO MOISTURE CONTENT OF STORED DEHYDRATED PRODUCTS

It has been long recognized that dehydrated products will absorb moisture from the air. In order to examine more closely into the relationship between the relative humidity of the storage atmosphere and the moisture content of the stored product, small quantities of various dried foodstuffs were exposed to atmospheres of known humidity.

The dehydrated foodstuffs used were potatoes, turnips, carrots, apples, cabbage, spinach and beets. The dried material was ground, two-gram samples were placed in the dishes in the humidity chambers, and similar samples were analysed (by the official AOAC method) for moisture content. Periodic examinations were made over a period of one year and moistures again determined by weighing. It was found that the samples had all reached an equilibrium in two weeks.

TABLE 33. RELATION OF ATMOSPHERIC HUMIDITY TO MOISTURE CONTENT OF STORED DEHYDRATED PRODUCTS

Product	Original moisture	Moisture content after 2 weeks at relative humidity of:—							
		10%	20%	30%	40%	50%	60%	70%	80%
	%								
Potato	5.26	1.3	2.3	3.8	5.4	6.8	8.9	11.5	18.3
Turnip	6.83	1.9	2.9	4.5	6.6	10.5	17.0	24.9	40.5
Carrot	4.67	1.5	2.4	4.0	6.2	10.0	15.6	23.8	35.5
Apple	18.12	4.9	6.7	7.8	9.7	13.5	19.8	27.5	46.0
Cabbage	3.80	1.5	2.3	3.9	6.1	10.1	14.9	21.5	35.0
Spinach	4.22	1.4	2.3	3.5	5.0	7.3	10.6	14.6	24.5
Beet	7.90	5.3	6.9	8.2	10.9	15.0	20.3	26.8	41.0

Moisture content in grams per 100 grams dry weight was plotted against relative humidity, and the values shown in Table 33 derived from the resulting curve.

While the curves for the products are similar in shape, the table above indicates that they differ considerably in formula, and the relation between moisture content and atmospheric humidity is different for each product.

Commercially dehydrated products are dried to different moisture contents. The most common moisture contents for these products is given in Table 34, together with the relative humidity at which storage air would be in equilibrium with them.

TABLE 34. EQUILIBRIUM POINTS FOR COMMERCIALLY DEHYDRATED PRODUCTS

Product	Moisture Content	Relative Humidity of Air
Potato	6.5%	49.0%
Turnip	5.0%	33.5%
Carrot	5.0%	35.0%
Apple	22.0%	63.0%
Cabbage	4.5%	33.5%
Beet	6.5%	14.5%

Storage Investigations

(G. W. Hope)

Influence of Tree Nutrition upon Keeping Quality of Apples

In 1933 observations were commenced on the relation of keeping quality to nutrition of the tree. Samples of 100 McIntosh and Gravenstein apples were used, and 25 of these were taken for each examination during storage. The fruits were examined externally for scald and rots and internally, by transverse sectioning, for breakdown.

The fertilizers applied included formulae containing nitrogen, phosphorus and potash alone and in combination, different sources of nitrogen (nitrate of soda and sulphate of ammonia) and of potash (muriate and sulphate); bonemeal, slag and manure. The orchard was in clean cultivation with cover crop and sod strip.

The results obtained during the five years this project was conducted may be summarized as follows: a complete fertilizer is more conducive to good keep (i.e., as measured by breakdown and core flush) than either no fertilizer or fertilizers containing one or two elements only.

Influence of Maturity and Storage Temperature on Keeping Quality of Apples

Bushel samples of Macoun and Cortland apples were collected at weekly intervals during the picking season and stored at 32, 35, and 38°F. Records of maturity were taken at the time of picking, using as indices the pressure test, starch-iodine test and ground-colour change. Subsequent records on keeping quality were made.

The starch-iodine test was found to be the most satisfactory index of maturity for apples. The best keep was obtained when the fruit was picked directly after the starch had disappeared from the core area. Immature apples developed mealy breakdown. Shrinkage was very pronounced in fruit picked at an immature or over-mature stage.

In McIntosh, core flush quickly developed in the immature fruits, and such apples stored at 38°F. soon wilted and assumed a flushed condition in the cortical tissue. Mould development was much more pronounced in the fruit picked during the later stages of ripening.

The limit of storage life of McIntosh at 32° and 35°F. appears to be approximately three months for the more mature fruit. There was little difference between apples stored at these two temperatures, except that the most mature apples exhibited less core flush and less scald at 32°F. than did corresponding samples at 35°F.

Macoun apples stored best at 38° and Cortland at 32°F.

Storage of Canning Pears

Clapp's Favourite is grown in Nova Scotia as a canning pear, and, ripening as it does some ten days before Bartlett, extends the season for the canneries. As grown here it makes an excellent canned product, but it deteriorates rapidly if held in common storage previous to canning. Attempts, therefore, were made at this Station to determine if this pear could be held in cold storage. A parallel experiment on the storage of Bartlett was conducted at the same time.

The pears were picked green-ripe and stored at 32° and 37°F. in common storage. To determine any effect due to the date of picking, lots were picked three and six days later and similarly stored. Portions were drawn at intervals of one week, ripened at 65°F. and canned. The canned product was held until all lots had been processed and then was examined and compared.

For both Clapp and Bartlett, 32°F. was found to be the best storage temperature. Clapp can be held at 32°F. for 14 to 17 days without loss of flavour or

colour; Bartlett can be so stored for four to six weeks. Clapp stored more than 17 days and then ripened and canned yields a product with a decided yellowish cast to the flesh, which is not acceptable to the trade.

Regardless of picking date, all fruit stored at 32°F. had better flavour than all fruit stored at 37°F. The earlier-picked fruit had better colour and flavour at both temperatures than did the fruit of the later pickings.

The ground colour of pears held at 37°F. becomes yellow when canning ripeness is reached, but Clapp stored at 32°F. for 17 days became canning-ripe without change in ground colour from green to yellow.

Storage of either variety for over three weeks at either temperature increased the difficulty of peeling with hot water dip. After five weeks' storage knife pealing was necessary.

The effect of storage temperatures and picking maturity was investigated in 1938-39 and in 1939-40. Clapp's Favourite pears picked at 17, 16 and 14 pounds pressure were stored at 32°, 35° and 38°F. Of the three temperatures, 32° was found to be the most suitable. Fruit harvested at 14 pounds pressure stored better at this temperature than did the other lots. At this stage and temperature they may be held for two months in storage.

A similar experiment using Bartlett pears also indicated 32°F. as the best storage temperature. With this variety later-picked fruit tended to scald more than the early lots. A harvesting pressure of 17 pounds appeared best for Bartlett.

KEEPING QUALITY OF WINTER PEARS

The keeping quality of a number of winter pears at 32°F. was investigated. These pears were stored at 32°F. for five months and then ripened for 10 days at 65°F. In brief, Clairgeau, Vermont Beauty and Cayuga were the varieties which offered the most promise with respect to storage.

KEEPING QUALITY OF PLUMS

The observation had been made that different varieties of plums appeared more susceptible to brown rot in storage when picked at full maturity than similar fruit picked slightly immature. To test the validity of this observation fruit of three varieties, Miller Superb, Quackenboss and Imperial Gage were picked on two dates six days apart, stored at 32°F. and then ripened at 65°F. for five days. Table 35 shows percentages of brown rot and breakdown found in these plums.

TABLE 35. KEEPING QUALITY OF PLUMS PICKED AT DIFFERENT DATES: WASTAGE IN STORAGE

Variety	Picked Sept. 8		Picked Sept. 14	
	Brown rot	Breakdown	Brown rot	Breakdown
	%	%	%	%
Miller Superb	50.0	0.0	83.0	0.0
Quackenboss	0.0	0.0	6.0	0.0
Imperial Gage	16.0	100.0	18.0	15.0

It will be observed that the later-picked fruits are more subject to brown rot, although with Imperial Gage this is more than offset by the high percentage of breakdown which developed in the early-picked fruit.

STORAGE OF FRUIT IN ARTIFICIAL ATMOSPHERES

Apples

The method of slowing down the respiratory activity of apples in storage by controlling the oxygen and carbon dioxide content of the storage atmosphere has been investigated at Kentville. Unfortunately, this work was temporarily discontinued during the war years. The results previous to this time, however, were of interest and are presented herewith in a summarized form.

The storage atmosphere was maintained at the required concentration of 5 per cent carbon dioxide by ventilation to remove respiratory CO_2 in excess of this amount. Fruit was stored in standard boxes of approximately one-bushel capacity.

McIntosh stored in 5 per cent CO_2 at 37°F. was still in good condition after seven months' storage. Golden Russet was in excellent condition after seven months at the same temperature in both 5 per cent and 10 per cent CO_2. Neither Cox Orange nor Ribston kept satisfactorily at either concentration at this temperature—possibly because of the long storage period. Ribston stored in 5 per cent CO_2 at 40°F. kept satisfactorily for three months and withstood shipping to the English market.

In 1937 a mixture of Golden Delicious, Ribston, McIntosh, Cox Orange, Wagener, Golden Russet, Red Delicious, and Cortland were stored together in 5 per cent CO_2 at cellar storage temperatures (52°–54°F.) and were all in good condition when examined after three months.

McIntosh stored in 5 per cent CO_2 at cellar-storage temperatures was still sound twenty-nine weeks later. Flavour was unimpaired and only 2.1 per cent of the fruit was rotted. Similar fruit stored in air had 100 per cent cortical flush, was badly shrunken and had 13.5 per cent rot when examined after fourteen weeks' storage.

Wagener remained free from scald in gas storage until mid-January, when scald developed under both atmospheres and at all temperatures, even when the apples were packed with oiled paper.

Cox Orange stored well in 5 per cent CO_2 at cellar storage temperature, but did not respond well in another year to 5 per cent CO_2 at 37°F. Golden Russet developed slight scald in May, but otherwise was in excellent condition. Baldwin showed 24 per cent core flush in May when in cellar storage under 5 per cent CO_2, as compared with 8 per cent core flush in similar fruit stored in air. Red Spy showed more mould development in gas than in air (16 per cent as against 1 per cent). Cortland did not appear to receive any particular benefit from gas storage.

ANIMAL HUSBANDRY

(R. H. McDowell)

BREEDING DUAL-PURPOSE SHORTHORN CATTLE

The Shorthorn herd on January 1, 1937, numbered thirty-eight head, consisting of the herd sire, Revelation-222969, seventeen cows, one two-year-old heifer, six yearlings, ten heifer and three bull calves.

Revelation was by Resolution-202726, by Rosewood Count-194434, out of Missie 82-230602. His dam, Augusta 80-205597 was by Maxwelton Moneybags, 159123, out of Augusta-168287. The good line breeding of this bull made him a prepotent sire.

In November, 1937, Coldoch King-229423, was purchased. He was by Coldoch Rosewood King-219903, by Kinellar Obligant (Imp.) (258299), out of Coldoch Rosewood (143325). His dam, Elmcroft Augusta-168287, was by Bruich Champion-115525 (Imp.), out of Cluny Augusta 11-132760 (Imp.). The dam of Coldoch King was also the maternal granddam of Revelation. This bull did not prove satisfactory and was not used as extensively as Revelation.

The next sire, Cossar Standfast-226735, was by Kelmscott Leader 12-220721 (Imp.) by Kelmscott Ringleader 46. His dam, Cossar Dimple-230470, was by

Kentville Pioneer-163537, and out of Dorothy-201814. The daughters of this bull proved to be very good milkers, leaning to the dairy type. The semen of this bull, however, proved to be very weak and a junior sire was purchased in November, 1941. This was Cossar Wild Eyes Prince-244355. He was by Cossar Standfast, and out of Sally Wild Eyes 30 (Imp.), an R.O.P. cow with 10708 pounds of milk and 404 pounds of fat in 305 days. His progeny also were good milkers and of dairy type.

The last sire used was Neralcam Royal Crown-264861, by Willingdon, by Fairy Duke. His dam, Mary Rose-286989, was also by Willingdon. Only a few calves were dropped after this bull before the herd was transferred to the Experimental Farm at Nappan, N.S.

For approximately the last nine years during which the herd was at this Station there was a natural increase of 154 head. Seventy-one bull calves and forty-four females were sold as breeders, seven males and fifteen females for beef, and four calves and two cows died. A summarized report for this period shows that on the average eleven cows were milking and 2.9 were dry; the average age was 5 years and 5 months; and the average yearly production, 5269 pounds of milk and 213.3 pounds of fat. The average number of pounds of grain fed per cow per year was 1678; ensilage, 5089; hay, 3697; roots, 2522; green feed, 1211. The average yearly days on pasture was 137.

Record of Performance, Dual-purpose Shorthorns

All normal cows in the herd were carried in the Record of Performance test until October, 1945, at which time the herd was transferred to the Experimental Farm at Nappan.

TABLE 36. RECORD OF PERFORMANCE, DUAL-PURPOSE SHORTHORNS, 1937-1945, INCLUSIVE

Number of records in 9 years	Class	Average amount of milk	Average amount of fat	Average number days in milk
		lb.	lb.	days
33	Mature	7,095	277	304
4	4-year	6,834	284	288
6	3-year	5,567	226	300
18	2-year	5,507	234	343

Record of Performance, Guernseys

During the two years that the Guernsey herd has been at this Station, twenty R.O.P. records were made, averaging 8214 pounds of milk and 391 pounds of fat in an average of 357 days.

TABLE 37. RECORD OF PERFORMANCE, GUERNSEYS, 1946-1947

Number of records in 2 years	Class	Average amount of milk	Average amount of fat	Average number days in milk
		lb.	lb.	days
2	Mature	9,552	423	365
4	4-year	8,723	425	365
4	3-year	8,532	393	358
10	2-year	7,636	361	352

The average monthly costs for the Shorthorns over an approximate 9-year period, January, 1937, to October, 1945, are given in Table 38 and for the Guernseys for 1946 and 1947 in Table 39.

TABLE 38. AVERAGE COST OF MILK AND BUTTERFAT PRODUCTION, DUAL-PURPOSE SHORTHORNS, BY MONTHS, 1937-1945, INCLUSIVE

January, 1937, to October, 1945	Feed cost per 100 pounds of milk	Feed cost per pound of butterfat
	$	$
January	1.45	0.352
February	1.45	0.349
March	1.34	0.340
April	1.28	0.306
May	1.10	0.279
June	0.58	0.146
July	0.93	0.229
August	1.16	0.286
September	1.35	0.326
October	1.40	0.334
November	2.05	0.489
December	1.98	0.487

TABLE 39. AVERAGE COST OF MILK AND BUTTERFAT PRODUCTION, GUERNSEYS BY MONTHS, 1946 AND 1947

January, 1946 to December, 1947	Feed cost per 100 pounds of milk	Feed cost per pound of butterfat
	$	$
January	2.06	.435
February	1.89	.392
March	1.82	.380
April	1.78	.369
May	1.27	.260
June	0.78	.157
July	0.76	.172
August	1.27	.257
September	1.67	.389
October	1.99	.435
November	1.70	.382
December	1.79	.372

Grain was charged at the actual market value, and the hay, roots and other home-grown feeds at prices based on the cost of production. The feed charged to the Guernseys was, of course, much higher in price than that charged to the Shorthorns.

Fig. 13—Heifers on Alfalfa After-feed at the Experimental Station, Kentville, N.S.

Feeding Value of Apple-juice Concentrate

In a comparative test of a grain ration and apple-juice concentrate, eight heifers were selected and divided into two lots of as nearly equal weights as possible. One lot was fed hay, roots and meal mixture, and the other lot, hay, roots, apple-juice concentrate and fish meal. The quantity of the carbohydrates and proteins was essentially the same in the meal mixture as in the apple-juice concentrate and fish meal. The meal mixture was made up of 48 pounds ground oats, 48 pounds ground barley and four pounds fish meal. Salt was also fed to all the animals at regular intervals.

The test started November 15, 1941, and continued until May 15, 1942, a total of 181 days. Each animal was weighed at sixty-day intervals and again at the end of the test. They ran loose in pairs in pens but were tied up at feeding time. All had free access to water.

The average gain per day per lot over the whole period was 4.121 pounds for those fed the meal ration and 4.277 pounds for those fed the apple-juice concentrate plus fish meal. No difference was evident in the general health of the two lots.

Under the conditions of this test, apple-juice concentrate and fish meal were a satisfactory substitute for a standard grain ration.

Apple-hay Ensilage vs. Corn Ensilage for Milk Production

The animals for this test were selected in pairs as they became available in the herd, four pairs as evenly matched as possible being used. One cow in each pair was started on apple-hay ensilage and one on corn ensilage. Each period was of 30 days' duration with a seven-day transition period. At the end of each transition period the rations were reversed. The experiment ran for three ration and reverse-ration periods. The grain ration remained constant at six pounds per cow throughout the test. Complete records of weight of the cows, milk and butterfat production, feed, etc., were kept.

The corn ensilage used in this test was from the standard stave silo and was prepared in the usual way. The apple-hay ensilage was made up of 6750 pounds of clover hay, 53460 pounds of apples and 90 pounds of calcium carbonate, or 88.8 per cent apples and 11.2 per cent hay. The calcium carbonate was used to minimize the acidity of the silage.

Seventeen pounds of silage and three pounds of meal were fed to each cow, both morning and night. Hay was fed at the rate of one pound of hay to 100 pounds of body weight.

The results of this trial showed an average shrinkage of 20 per cent in milk when feednig of the corn silage followed the apple-hay silage, and a shrinkage of 9.8 per cent when the apple-hay silage followed the corn silage. As the average monthly shrinkage is about 12 per cent, it would seem that in this short test the apple-hay silage made a good showing. The butterfat test showed no difference when the corn silage followed the apple-hay silage, and a slight average increase of 0.3 per cent when the apple-hay followed the corn silage.

A Comparison of Clover-hay, Apple-pomace Ensilage and Apple-skins-and-cores Ensilage as Pasture Supplements

In this test the apple pomace was made from a mixture af various late apples, with a high proportion of Ben Davis. The skins and cores were discarded by the factory in the initial process of preparing apples for canning. These were put in the silo during late March and early April. The silos were of the snowfence and fibreen-paper type.

The silos were opened the middle of July and both products were in excellent condition with very little waste. The pomace silage was in good physical condition, a little dry if anything. The skins-and-cores ensilage was very wet, and dripped on handling.

These products, on coming out of the silo, had the analysis given in Table 40.

TABLE 40. APPLE-WASTE ENSILAGE: ANALYSIS BEFORE USE

	Pomace ensilage	Skins-and-cores ensilage
	%	%
Moisture	70.90	87.80
Protein (N x 6.25)	2.78	1.20
Ether extract	1.53	0.70
Ash	0.93	0.47
Crude fibre	8.44	3.63
N-free extract	15.42	6.20
	100.00	100.00

It will be noted that the skins-and-cores ensilage provided approximately half the dry matter contained in the pomace ensilage.

The cows received only pasture from May 27 until the beginning of the test, July 10. At that time the milking herd was divided into three groups and fed, respectively, freshly cut and cured hay in the quantity they would normally consume, 40 pounds per day of pomace ensilage, and 40 pounds per day of skins-and-cores ensilage. In addition, all animals were fed four pounds of mixed grain per day during July. During August and early September they were fed mixed grain at the rate of one pound for every four pounds of milk produced.

Using the figure 100 to represent the production during the pre-test period, the average production on pomace was 81.2; on clover hay, 69.1; and on skins and cores, 68.9.

From this test it was concluded that it is quite practicable to make ensilage from these fruit by-products.

Skins and cores alone contain somewhat more water than is desirable, so that a mixture of approximately two-thirds pomace and one-third skins and cores would make a more desirable mixture from the physical standpoint.

The ensilage produced no appreciable off-flavours in the milk.

A minor objection was the presence of a large number of fruit flies attracted by the ensilage.

Ensilage of both apple types was satisfactory in maintaining milk production when used as a supplement to a failing pasture, and the pomace ensilage was somewhat more effective than the clover hay.

For the quantities fed in this experiment, the pomace ensilage was superior to the skins-and-cores ensilage in maintaining the milk flow, but this might not be true if the two products were fed on the basis of equal quantities of dry matter.

A Comparison of Apple-hay Ensilage, Dehydrated Apple Pomace and Regular Meal Mixture for Beef Production

In this test the ensilage was made up of 6750 pounds of clover hay, 53460 pounds of apples and 90 pounds of calcium carbonate. This is in the proportion of 88.8 per cent of apple and 11.2 per cent of hay. The calcium carbonate was used to reduce the acidity of the ensilage. This ensilage was stored in the regular stave silo. The dehydrated apple pomace used was the residue from a press after the juice had been extracted, dried to about 12 per cent moisture. The regular meal mixture was made up of 48 pounds of ground barley, 48 pounds of ground oats and 4 pounds of fish meal.

Twelve young cattle, nine heifers and three steers were selected for this feeding test, and were divided into three lots of one steer and three heifers each. The ration fed to each lot contained practically the same dry matter, digestible crude protein and total digestible nutrients. All three rations were palatable and readily eaten. There was a large loss of weight in the ensilage, apparently due to a draining away of the apple juice. A larger percentage of clover hay might have prevented this loss.

The test began with full rations on December 1, 1940, and continued until April 23, 1941, a period of 144 days. The animals were weighed at thirty-day intervals and at the end of the period.

Each lot ran loose in a separate pen, and were tied in stanchions with individual mangers at feeding time. They had free access to water. The results of the test are summarized in Table 41.

TABLE 41. A COMPARISON OF APPLE-HAY ENSILAGE, DEHYDRATED APPLE POMACE AND REGULAR MEAL MIXTURE FOR BEEF PRODUCTION

Kind of feed	Average total gain per animal	Average cost per pound of gain
	lb.	c.
Meal ration	139.0	11.80
Dehydrated pomace	140.0	13.93
Apple-hay ensilage	147.5	11.80

Under the conditions of this experiment the apple-hay ensilage gave slightly better returns than either the meal ration or the dehydrated pomace.

Control of Tuberculosis in Cattle

In co-operation with the Health of Animal Division of the Production Service, the animals are tuberculin-tested annually as a Canadian tuberculosis-free accredited herd. The accredited-herd certificate was granted in 1946 for the twenty-fourth consecutive year.

Serum Test for Contagious Abortion

The herd was tested for contagious abortion by the veterinary inspectors of the Health of Animals Division, each year with the exception of 1943. (No test was given between October, 1942, and January, 1944).

During the ten-year period, 1937-1946, inclusive, a yearly average of forty-four head were given the test. One cow gave a positive reaction in 1940 and was immediately sold for beef. The herd received three tests during that year, all of which proved negative. In 1944 two cows having a questionable reaction were isolated and tested again in thirty days, when they proved negative. In 1945 one heifer was questionable and was tested five times before a negative test was received. One young cow which lost her calf at seven months was given a blood test thirty days later and proved negative.

A high level of general health is maintained by regular care and the feeding of balanced rations. Daily spraying of the stable with a disinfectant follows the removal of the manure. Pens are treated in the same way when cleaned out, with special attention to those used as maternity quarters. A barrel sprayer is used for this work.

Poultry

(B. F. Chency)

All investigational work during the years 1937 to 1946 was done with the flock of single-comb White Leghorn hens maintained at the Kentville Station. Brief summaries of the findings during this period are given herewith.

Best Date for Incubation

To determine the best date for incubation with regard to fertility, hatchability and livability, eggs were hatched during the months of March, April and May, and records kept concerning the above factors of chicks to three weeks of age. The results for 1939 and 1940 are given in Table 42.

TABLE 42. BEST DATE FOR INCUBATION (AVERAGE FOR TWO YEARS: 1939, 1940)

Date of hatch	Eggs set	Per cent fertile	Per cent of fertile to hatch	Per cent of total to hatch	Per cent of mortality to 3 weeks
		%	%	%	%
March	749	95.9	58.5	56.1	0.5
April	1,962	97.0	67.6	65.5	1.5
May	851	98.0	70.9	69.4	1.0

It will be noted that late hatching tends to increase the percentage of fertile eggs and the hatchability of fertile eggs.

Pedigree Breeding for Egg Production

A careful check was kept of the production records of different families of birds for the purpose of determining the best birds to be retained for breeding, with a view to raising the production level of the flock. Table 43 (a) shows the average pro-

duction of birds saved for breeding during the past ten years; Table 43 (b) the percentage of these birds showing no winter pause.

TABLE 43. PEDIGREE BREEDING FOR EGG PRODUCTION

(a)				(b)	
Year	Average production	Year	Average production	Year	Percentage showing no winter pause
					%
1937	225	1942	252	1942	36
1938	248	1943	254	1943	56
1939	243	1944	270	1944	60
1940	235	1945	266	1945	64
1941	250	1946	292	1946	81

It would appear that selection for breeding has considerably improved the flock, which in turn has improved production.

If the production records of the birds saved for breeders are considered from 1927 on, the progress made appears even more impressive. These figures are given for five-year periods in Table 44.

TABLE 44. AVERAGE EGG PRODUCTION, IN FIVE-YEAR PERIODS, FROM 1926 TO 1946 INCL., OF HENS SELECTED AS *BREEDERS* AT KENTVILLE STATION

Period	Average number eggs produced
1926	168.0
1926-1930	203.4
1931-1935	226.3
1936-1940	235.8
1941-1945	258.4
1946	292.0

Relation of Specific Gravity of the Egg to Its Hatching Power, to Chick Livability, and to Productiveness and Livability of the Pullets

An investigation is in progress at Kentville to determine whether the hatching power of fresh eggs can be measured by a specific-gravity test, and whether there is a relationship between the specific gravity of the eggs, the livability of the chicks and the livability and productiveness of the pullets.

All pedigree eggs were tested for specific gravity in salt solutions and the birds grouped according to the average specific gravity of their eggs.

It was found that specific-gravity readings could be correlated with egg-shell strength as determined by the amount of pressure required to pierce the shell with a fine needle point. During 1945 and 1946, specific-gravity readings were replaced by penetrometer readings.

The relation between specific gravity readings and the puncture-strength of the shell at five points: one on the air-cell of the egg and four around the sides, is shown in Table 45.

TABLE 45. RELATION BETWEEN SPECIFIC GRAVITY OF EGG AND PUNCTURE STRENGTH OF SHELL (1941)

Number of Eggs	Specific gravity	Puncture-strength					Average puncture-strength
		Air-cell end	Side punctures				
			1	2	3	4	
		gm.	gm.	gm.	gm.	gm.	gm.
20	1.074	589	581	615	595	590	594
40	1.078	671	658	653	639	651	654
44	1.082	734	750	742	750	748	745
18	1.086	800	812	792	817	828	810

It will be noted that as specific-gravity increased, the egg-shell strength increased. There is evidence that the damage done when more than one puncture is made affects hatchability. Due to the fact that the puncture on the air-cell end of the egg does little if any damage and that these readings show the same trends as the average of the final readings, it was decided to do all future work by puncturing the air-cell end.

From 1941 to 1946 penetrometer readings were taken of all eggs laid during the breeding season, and of eggs laid by the pullet progeny from these eggs during November.

The penetrometer readings, showing the average egg-shell strength of the flock over a period of five years are given in Table 46. These were taken from eggs laid by pullets during November.

TABLE 46. AVERAGE EGG-SHELL STRENGTH, FIVE YEARS, NOVEMBER: 1942 TO 1946, INCL.

Year	Average reading	Variation between progeny of different sires
	gm.	gm.
1942	1,085	150
1943	967	126
1944	1,225	245
1945	1,211	210
1946	1,010	32

No consistent improvement in shell strength has been obtained during the past five years of the period under review. However, evidence has come to hand showing that shell strength may be an index to the general physiology of the birds. As shown in Table 47 there has been a considerable reduction in mortality in the past two seasons, 1945-46 and 1946-47.

TABLE 47. MORTALITY OF FEMALE PROGENY OF BIRDS LAYING THIN- AND THICK-SHELLED EGGS. (SIX YEARS, 1941-42 TO 1946-47, INCL.)

	Number of progeny	Per cent mortality
		%
1941-42		
Dams' eggs below 1.080 specific gravity	28	28.6
" " over 1.085 " "	100	17.0
1942-43		
Dams' eggs below 1.080 specific gravity	72	11.1
" " over 1.085 " "	109	18.2
1943-44		
Dams' eggs below 1.080 specific gravity	44	15.9
" " over 1.085 " "	150	9.4
1944-45		
Dams' eggs below 1.080 specific gravity	86	32.6
" " over 1.085 " "	94	13.8
1945-46		
Penetrometer pressure below 1,050 grams	73	11.0
" " over 1,190 "	232	4.3
1946-47		
Penetrometer pressure below 1,050 grams	108	10.2
" " over 1,190 "	127	4.7

The young cockerels retained to supply the breeders in the flock are compared in Table 48.

TABLE 48. RELATION BETWEEN SHELL QUALITY OF DAMS AND VIGOUR OF COCKEREL PROGENY, 1946-47

Group	Birds placed on range	Birds banded	Per cent banded	Per cent of banded that were Grade A
Heavy-shells	30	23	76.7	48.0
Controls	30	18	60.0	33.3
Light-shells	14	4	28.6	0.0

It will be seen from these records that a close association is already apparent between shell quality and vigour as far as cockerels are concerned, and that the application of this method of selection may be of considerable value where large numbers of breeding cockerels are required.

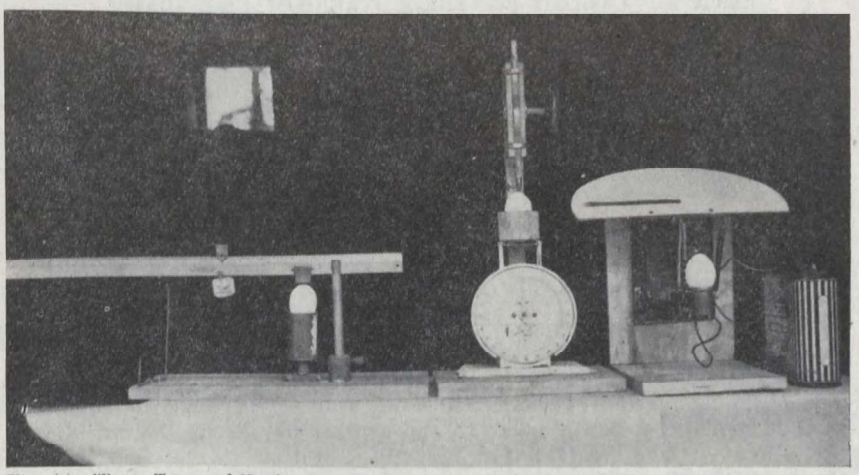

Fig. 14—Three Types of Equipment (Lever, Spring Balance, and Electric Pressure Needle), Designed at the Experimental Station, Kentville, N.S., for Testing Eggshell Strength.

Three types of penetrometers are illustrated in Fig. 14 photograph at left:

Left.—Egg is placed in cup, ruler with needle point inserted in rubber is allowed to rest gently on top of egg. Weight is gradually moved out on beam until point is reached where needle punctures egg. Measurements on beam indicate grams pressure applied.

Centre.—Small spring scale with platform replaced by egg cup. Beam with needle inserted is gradually brought down on top of egg and pressure gently applied until needle point breaks through shell. Readings on dial indicate grams pressure.

Right.—Beam with needle point. Air-cell end of egg is placed in cup and pressure applied by hand until needle point pierces egg. By means of magnet and battery the moment needle point pierces egg, dial remains stationary until pressure is released. This allows for more accurate readings.

Flock Management

The birds were confined to the brooder houses until seven weeks of age. Approximately 250 chicks per brooder were placed in pens 16 by 16 feet. All feed and water were placed up off the floor on wire-covered frames. Until 1946 all pens were thoroughly cleaned twice each week and freshly covered with a gravel litter. In 1946 gravel was used for the first two weeks, after which shavings were added to the litter each week. No litter was removed except that wet by splashing from the water founts. Both methods of brooding proved entirely satisfactory, the latter requiring considerably less labour.

The poultry yards were operated on a two-year rotation, one-half being alternately seeded to grain and clover each year.

During the period under review, there were no set-backs due to intestinal parasitism, and it would appear that a two-year rotation can be operated satisfactorily with up to 500 pullets per acre, provided the land is well drained, the fertility of the soil maintained, and the green growth kept cut.

Cost Studies

BROODING COSTS

An account was kept of all feed and fuel used in rearing the flock. The birds were weighed at six weeks and again on reaching maturity, to determine the cost per pound of gain.

(a) Brooding cost to six weeks: 1939, 1940, 1941.

During the period from hatching to six weeks of age the chicks consumed approximately two pounds of mash per chick to one pound of grain, with the feed cost per chick ranging from 7.42 to 8.7 cents, depending on the price of feed.

(b) Fuel costs with hard coal at $18.00 per ton, averaged, over a three-year period, 2.25 cents per chick to six weeks.

REARING COSTS

The cost of rearing poultry in this district from six weeks to maturity was studied by keeping an account of all feed used by pullets on range. The birds were weighed at six weeks and again at banding time, to determine the cost per pound of gain.

The average feed consumption during the range period, for the three years (1939-1941), was 5 pounds of growing mash and 14 pounds of grain, per pullet.

The cost per pound of gain was 12.4 cents for 1939, 14.3 for 1940, and 15.9 cents for 1941, or a three-year average of 14.2 cents. The cost of rearing cockerels is given in Table 49. (Mash at $2.00 per cwt. and buttermilk at 35 cents per cwt.).

TABLE 49. COST OF REARING COCKERELS (AVERAGE FOR THREE YEARS, 1939-1941, INCL.)

Period in weeks	Initial weight	Final weight	Gain	Feed consumed		Feed cost	Feed cost per pound of gain
				Mash	Milk		
	lb.	lb.	lb.	lb.	qts.	$	c.
6– 8	65	102	37	111	..	2.22	6.0
8–10	102	130	28	125	..	2.50	9.0
10–12	130	160	30	137	..	2.74	9.1
12–14	160	199	39	167	17	3.49	9.2
14–16	199	230	31	175	28	3.75	12.1
16–18	230	252	22	203	20	4.24	19.3

This table indicates the advisability of disposing of Leghorn cockerels shortly after they are twelve to fourteen weeks of age, when they should weigh approximately three pounds.

COST OF PRODUCING CAPONS

In this investigation, White Leghorns and cross-bred capons (Rocks × Leghorns) were used to determine the feed costs in the production of capons. The birds were caponized at six weeks of age and an accurate account kept of all feed consumed. The weights of the birds were determined every two weeks. The findings are presented in Table 50. (Mash cost, $2.00 pr cwt., and milk 35 cents per cwt.).

TABLE 50. (a) COST OF FEED TO PRODUCE 54 WHITE LEGHORN CAPONS (1939)

Period in weeks	Initial weight	Final weight	Gain	Feed consumed		Feed cost	Feed cost per pound of gain
				Mash	Milk		
	lb.	lb.	lb.	lb.	qts.	$	c.
6 –8	56	87	21	110	..	2.20	10.5
8–10	87	112	25	135	..	2.70	10.8
10–12	112	134	22	126	..	2.52	11.5
12–14	134	179	45	177	16	3.68	8.2
14–16	179	219	40	188	26	3.98	10.0
16–18	219	253	34	172	24	3.65	10.7
(b) COST OF FEED TO PRODUCE 54 ROCK X LEGHORN CROSS-BRED CAPONS (1939)							
6 –8	75	103	28	115	..	2.30	8.2
8–10	103	139	36	133	..	2.66	7.4
10–12	139	183	44	166	..	3.32	7.6
12–14	183	215	32	151	13	3.14	9.8
14–16	215	255	40	186	18	3.88	9.7
16–18	255	290	35	218	24	4.57	13.1

The cost per pound of gain of cross-breds shows a considerable increase in the last two weeks, possibly indicating they had reached the end of their most economical gains at sixteen weeks.

TABLE 51. COST OF EGG PRODUCTION, 1942-1946, INCL.

Year	Number of birds	Total eggs laid	Average value per doz.	Feed cost	Feed cost per doz.	Profit over feed per doz. eggs	Per cent of production	Per cent of mortality	Profit over feed per bird
			c.	$	c.	c.	%	%	$
1942	400	73,776	32.3	806.47	13.1	19.2	60.0	17.0	2.95
1943	400	77,358	37.1	825.57	12.8	24.3	60.3	13.0	3.91
1944	500	97,923	34.9	1,119.92	13.7	21.2	64.5	15.0	3.45
1945	456	74,653	33.9	1,007.83	16.2	17.7	55.2	26.0	2.41
1946	600	139,117	35.2	1,649.51	14.2	21.0	70.6	6.0	4.07

The production records, the feed costs and the profits were kept over a five-year period, 1942-1946, and are tabulated in Table 51. The feed prices during this period changed very little: grain from $2.25 to $2.50 per cwt.; mash from $2.75 to $3.00; grit, $1.00; greens, 50 cents, and skim-milk, 30 cents per cwt., throughout. The profit over the cost of feed per bird ranged from $2.41 in 1945 to $4.07 in 1946, and would appear to be in close relationship to the rate of mortality.

Due to the necessity of culling the flock and putting the houses in shape for the new crop of pullets the period covered each year is the eleven months from October 1 to September 1, inclusive.

Apiary

(E. D. Craig)

During the 10-year period under review, an average of 65 to 70 colonies of bees have been kept at the Kentville Station for experimental purposes and demonstration work.

Poisoning of bees, brought about by arsenicals used by orchardists in their control of insect pests, has compelled apiarists throughout the Annapolis-Cornwallis Valley to practice migratory beekeeping during the spraying period. All the colonies at this Station, except those used in experimental work in the spring, are moved out of the orchard area until all danger of poisoning is over. During the past three years of the period under review, fifteen colonies have been kept in the Station apiary during the spray period to determine if a practical method of avoiding poisoning can be established. Work along these lines is continuing.

During the active season, extension and demonstration work is carried on among the beekeepers of the province.

Honey Flows

Since 1919, records have been kept to determine the time, length, density and source of honey flows, and the weather conditions affecting them.

A colony was kept on scales during the active period of honey gathering, and its weight taken every morning. In this way the daily gain or loss was recorded. This also showed the length of the honey-flow period. At the end of each period the honey was extracted and the total amount for the period determined. The shade temperature, minimum temperature, weather, wind and rainfall were also recorded. The results for the period of this report are given in Table 52.

TABLE 52. HONEY FLOWS, KENTVILLE: AVERAGE OF TEN YEARS, 1937-1946, INCL.

Kind of honey flow	Period of bloom	Average amount honey extracted	Average net gain shown by scales	Average number of days hive gained in weight
		lb.	lb.	
Fruit bloom	May 20–June 14	Nil	9.15	7.0
Clover	June 28–Aug. 1	59.0	75.08	20.3
Fall flow	Aug. 7–Sept. 29	42.4	52.65	17.3

A surplus of fruit-bloom honey has not been harvested since 1925. This is due, in the main, to the poisoning of bees by arsenicals used in the control of insect pests.

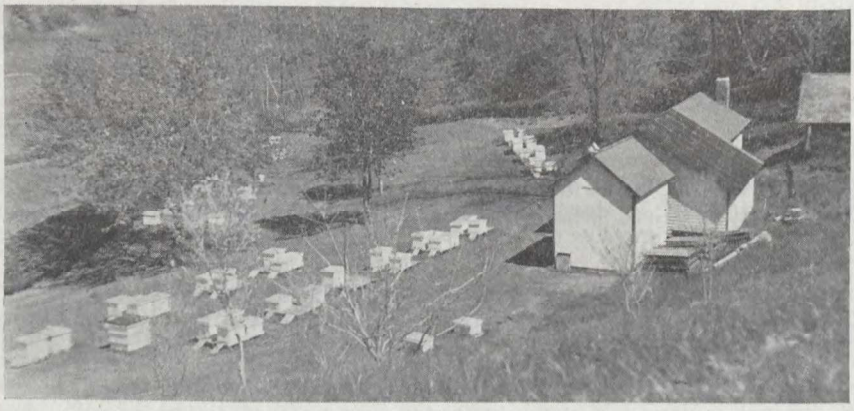

Fig. 15—Apiary at the Experimental Station, Kentville, N.S., showing Hives, Storeroom, Honey House and Storage Cellar.

Methods of Supering Colonies during a Honey Flow

A comparison of methods of supering colonies at this Station was started in 1938 to determine the effect on honey storage of the placement of supers. In the orthodox method the super added during the honey flow is placed immediately above the brood chamber and below the super already present. In the other method used (top supering) the super is placed on top of the one previously added.

During the nine years that the two methods of supering were carried out, four colonies of approximately equal strength were used. The results are shown in Table 53.

TABLE 53. COMPARISON OF SUPERING METHODS: AVERAGE OF NINE YEARS, 1938-46, INCL.

Group	Total number of colonies in group	Total crop of honey produced	Yearly average crop of honey produced per colony
		lb.	lb.
Old method	36	3,995	110.97
Top supering	36	3,455	95.97

It will be seen from this table that the average crop of honey produced where the old method of supering was followed exceeded that produced under the top-supering method. However, this extra honey would not offset the labour and time

involved in removing the heavy supers of honey, especially in a commercial apiary. Where only a few colonies are kept and labour is not a factor to consider, colonies supered by the old method would give a greater return.

Queen Breeding

The work of queen breeding has been one of the main projects carried on in the apiary for the past twenty years. Its purpose has been the development of a strain of Italian bees whose queens are prolific and whose workers are gentle, of good colour, do not swarm and are good honey gatherers. Previous to 1939, the breeding stock used was from colonies having the above characteristics.

A multi-queen colony

In the early fall of 1938 a colony in the Station apiary provided itself with a young fertilized queen, but, contrary to general practice, did not destroy the old queen.

On May 12, 1939, the colony was examined; both queens were found present and laying on the same comb and on the same side of it. Throughout the summer the colony was examined periodically. On August 24 a third queen was found to be laying along with the other two.

Unfortunately, this colony suffered heavy losses in brood and bees, from poisoning by arsenical sprays applied to fruit trees during the latter part of May and early June. However, they regained their strength by the time the clover flow was on and stored more honey than the majority of the colonies which had escaped poisoning by being removed from the orchard area during the spray period. When this colony was prepared for the winter of 1939-40 all three queens were present and the life of the colony was proceeding in an otherwise normal way.

On examining the colony the following spring, only one queen was present.

In the spring of 1940, fourteen colonies headed by queens raised in 1939 from larvae of the multi-queen colony were moved to a site where the mating of queens raised from this strain could be controlled. From these, eighteen queens were raised and used in re-queening the other colonies. Since 1940, all the queens raised are direct descendants of the queen of the multi-queen colony.

Non-swarming strain of bees

After twenty years of breeding queens at this Station by careful selection of the breeding stock, swarming has been eliminated and a strain of bees has been developed that is gentle and is good at honey-gathering.

Poisoning of Bees from Orchard Sprays

The major problem confronting the beekeepers in the Annapolis Valley is to find a way to combat the heavy arsenical poisoning of bees prior to, and immediately after, the blossoming period of the apple. Until something can be found that will keep the bees away from the apple blossoms during this period, beekeeping cannot become a commercial proposition in the Valley. In the meantime, the practice of migratory beekeeping is the only remedy. The first investigations centred around the use of repellents.

Creosote as a repellent

Preliminary experiments, designed to test the efficiency of commercial creosote as a repellent for bees in an apple orchard and on ornamental trees, were undertaken

in the spring of 1943. Nine trees in the cider-apple orchard at the Experimental Station were sprayed on June 4. The trees were at a stage just prior to full bloom, and the weather was overcast, with the temperature slightly, above 60°F. This type of weather prevailed throughout most of the blossoming period in 1943.

On the control plot, the regular Sulforon and lead arsenate orchard spray was applied to three trees of Pomme d'Or and one tree of Reinette du Canada.

On the second plot, one pint of creosote to 100 gallons of regular Sulforon and lead arsenate spray was applied to two Pomme d'Or trees, one Reinette du Canada and one Blanc Mallet.

On the third plot, the creosote was increased to one quart per gallons of the regular spray, and applied to two Pomme d'Or trees.

There seemed to be no decisive effect on the foliage, although that of the trees receiving creosote seemed a little lighter green in colour than that of the trees receiving only Sulforon and lead arsenate. There seemed to be no difference in its effect on the different varieties of tree, and no apparent difference in the results from the one-pint and two-pint concentrations.

Trees of Pomme d'Or sprayed with Sulforon and lead arsenate alone, and with creosote at one pint in 100 gallons of spray, had medium and light sets of fruit, whereas the two Pomme d'Or trees sprayed with the quart concentrations of creosote set light and very light crops. A heavy set of Reinette du Canada fruit was recorded on the tree receiving no creosote; on the other tree receiving one pint of creosote in 100 gallons of spray there was no fruit set. Blanc Mallet, with the latter treatment, set a medium crop of fruit.

Ten-minute counts of honey bees, wild bees and bumble-bees on branches of apple trees sprayed with creosote were taken June 4, 7 and 8. All the counts were rather low, but seemed to show that the creosote treatments had no repellent effect whatsoever upon the bees.

CREOSOTE ON ORNAMENTALS

Since the weather was cool enough to keep bees from travelling very far from their hives, an additional treatment was made with creosote in water alone on part of a clump of caragana trees in full bloom near the Station apiary. These were sprayed during the late afternoon of June 4. At the time of spraying, honey bees were working the caragana blossoms in large numbers, and within ten minutes after spraying large numbers of bees again were working the blossoms. On the three days following this treatment, the honey bees continued to work the caragana flowers, with apparently no preference for or against the treated trees.

CONCLUSIONS

It appears that under the conditions of this experiment the use of creosote up to one quart in 100 gallons of Sulforon and lead arsenate spray has no apparently harmful effect on the foliage of apple trees, nor has the material any repellent effect so far as wild bees, bumble-bees and honey bees are concerned. In addition, creosote at a concentration of one quart in 100 gallons of water had no effect in repelling honey bees from caragana trees in full bloom near the apiary.

SYNTHETIC POWDERED CAMPHOR AS A REPELLENT

Synthetic powdered camphor, 182 grains dissolved in 100 c.c. of alcohol, then mixed in two gallons of water, was applied to two caragana trees in full bloom, in 1946. Ten-minute counts of honey bees were taken on the branches of the two trees sprayed, and also on two caragana trees not sprayed. These are shown in Table 54.

TABLE 54. SYNTHETIC POWDERED CAMPHOR AS A BEE REPELLENT, KENTVILLE, 1946

Date	Treatment	Number of branches	Number of 10-minute counts	Total count honey bees
May 31	Control	1	2	30
	Camphor	1	2	12
June 3	Control	1	4	74
	Camphor	1	4	24
June 4	Control	1	2	20
	Camphor	1	2	12

From Table 54 it would appear that the camphor partially repelled the bees. It caused considerable burning of the foliage also.

SPECIAL FEEDING DURING THE SPRAY PERIOD

In 1947, the plan of feeding the bees during the spray period to keep them at home was considered, since repellents to keep them away from the sprayed orchards were apparently ineffective. Five colonies were fed sweetened water from May 19 to June 23, and given in addition an average of 3.6 pounds each of a pollen supplement, while five colonies were kept untreated as a check. The results are given in Table 55.

TABLE 55. CONTROL OF BEE POISONING BY SPECIAL FEEDING DURING THE SPRAY PERIOD

Treatment	Number of colonies in group	Average number of combs covered May 21	Average number of combs covered June 23	Total amount of honey produced	Average amount of honey produced
				lb.	lb.
Sweetened water plus pollen supplement	5	9.0	17.8	382	76.4
Check	5	9.2	12.7	265	53.0

All the check colonies showed evidence of poisoning, ranging from slight to heavy, while none of the fed colonies showed any injury.

WINTERING BEES IN QUADRUPLE CASES VS. CELLAR WINTERING

A test of the above two methods of wintering bees at this Station has been under way since 1930. All colonies were fed between October 10 and 18 each year. Immediately after the feeding was completed, four colonies were placed in each quadruple case. Four inches of dry planer shavings were used for packing between the hives and the case, with a tunnel through the packing left to connect the entrance of the hive with the flight-hole of the case. The top packing consisted of eight inches of shavings, over which a waterproof cover was placed.

The colonies to be wintered in the cellar were taken in the latter part of November. After the bees were in, humidity and temperature were recorded weekly. The results for the period of this report are given in Table 56.

TABLE 56. COMPARISON OF WINTERING METHODS: AVERAGES FOR TEN YEARS, 1937-1946, INCL.

Method	Average number of colonies	Average number of combs covered in the fall	Average number of colonies dead in spring	Average number of combs covered in the spring
In quadruple cases outside.....	40.3	9.90	2.5	6.2
In cellar.....	21.8	9.93	1.7	6.2

It will be seen from Table 56 that there was very little difference in the strength of the two groups of colonies when they went into winter quarters, or on the first examination in the spring (May 12), over this period. The deaths outside were slightly less.

The average relative humidity during the ten years the bees were in the cellar was 75.8, while the average temperature was 38.06°F. The lowest temperature recorded was 34°F. It is generally accepted that the optimum temperature range is from 40 to 45 degrees, but the lower temperatures registered apparently did not produce any harmful effects.

Field Husbandry

Ground Limestone and Commercial Fertilizers

(J. S. Leefe)

An experiment with ground limestone and commercial fertilizers, begun in 1914 and reported previously from this Station, was discontinued in 1943. The object of the test was to determine the value of ground limestone in conjunction with various fertilizer materials. The fertilizer schedules were changed on a number of occasions during the 30 years the test was in operation. While the quantities of fertilizer used were rather low by present-day standards and the yields as a result were low, the test does throw light on the long-term effect of limestone, and as such the results are valuable.

EXPERIMENTAL PROCEDURE

An area of one and one-fifth acres of medium gravelly loam was devoted to the experiment, containing four main ranges, two of which were limed in 1914, 1917, 1920 and 1923 at the rate of two tons per acre. The remaining two ranges have never received any limestone. Each of these four ranges was divided into six plots, each plot receiving a different treatment of chemical fertilizers. Thus, each fertilizer treatment, with and without limestone, was duplicated. A three-year rotation was used, a hoed crop being followed successively by grain and clover hay. Thus, any one crop was grown on the area only every third year.

In 1917, the yields recorded were so generally low, due to the light nature of the soil and its very low organic matter content, that an application of 15 tons of stable manure per acre was spread over the whole area. By 1926 the yields again were becoming low, and since the original applications of chemicals were at a very low level, the rates were trebled in the case of the nitrogen and phosphate fertilizers, and doubled with potash. From 1926 until 1938 the treatment remained constant, but in the latter year the layout was further changed to include (1) the growing of each crop in the rotation each year; i.e., each of the four ranges was divided into three sub-ranges, each one of which grew a different crop of the rotation each year; and (2) a comparison of all crops and treatments grown on soil treated and untreated with commercial borax at 20 pounds per acre, to determine whether the supply of boron in the soil had been depleted. In common with other fertilizers, the borax application was made only on the hoed crop. This change involved splitting the plots into equal halves, one of which received the borax treatment. The fertilizer treatments applied to the hoed crops follow.

ROTATIONAL CROPS GROWN

The hoed crop in this trial has been varied somewhat, having started as potatoes for four rotations or twelve years, then changed to mangels, and finally in 1938, to both mangels and swede turnips, the subranges being divided longitudinally to accommodate two rows of each crop. Potatoes were discontinued because of the extremely heavy potato scab infection on the limed areas. Except for two years early in the experiment when oats were grown, the grain crop has been wheat, and the third year of the rotation has been a mixed hay crop.

Table 57 gives the overall effect of ground limestone on the yields, for the period 1914-43, inclusive.

TABLE 57. GROUND LIMESTONE AND COMMERCIAL FERTILIZERS: EFFECT OF GROUND LIMESTONE DURING 30 YEARS, 1914-1943

Treatment*	Yields per acre				
	Wheat, 12-year average	Clover hay, 13-year average	Mangels, 9-year average	Swede turnips, 5-year average	Potatoes, 4-year average
	bu.	tons	bu.	bu.	bu.
With lime	9.9	1.52	271.0	441.8	191.3
Without lime	6.3	0.87	132.6	375.9	172.4
Difference	3.6	0.65	138.4	65.9	18.9
Per cent increase due to lime	57.1	74.70	104.4	17.5	13.6

* Limestone applications at two tons per acre, were made only in 1914, 1917, 1920 and 1923.

The outstanding results shown in this table are the beneficial effects of limestone upon the yields of mangels, clover and wheat, and the relatively small increases brought about by lime with potatoes and turnips. The increases with the former crops are so marked as to leave no doubt as to their significance.

EFFECT OF BORON ON YIELDS

Table 58 shows the effect on yields resulting from the application, in the year of the hoed crop, of 20 pounds of commercial borax per acre. These yields are inclusive of all years and all fertilizer treatments.

TABLE 58. GROUND LIMESTONE AND COMMERCIAL FERTILIZERS: EFFECT OF BORAX ON YIELDS

Treatment*	Yield per acre			
	Wheat, 5-year average	Clover hay, 4-year average	Mangels, 5-year average	Swede turnips, 5-year average
	bu.	tons	bu.	bu.
With boron	6.6	0.81	221.1	361.0
Without boron	6.6	0.75	166.5	371.0
Difference	0.0	0.06	54.6	-10.0
Per cent increase due to boron	0.0	8.00	32.8	-2.8

* Boron applications made to hoed crop only, 20 pounds borax per acre.

It will be seen from Table 58 that the element boron exerts a beneficial effect on the yield of mangels, resulting in a crop increase of nearly 33 per cent. From the individual plot records it was noticeable that the boron plots consistently yielded slightly less weight of turnips than the plots receiving no boron. This may have

been due to the fact that the severely brown-hearted roots on the no-boron plots have a higher moisture content than those with no brown-heart symptoms, such as were found on the boron-treated plots.

The effects of boron and lime upon the incidence of disease in mangels and turnips will be discussed in a later section.

EFFECT OF COMMERCIAL FERTILIZERS ON YIELDS

In Table 59 are shown the actual amounts used per acre of the various common sources of nitrogen, phosphorus and potassium.

As mentioned previously the nitrogen and phosphorus applications were trebled from 1926 on. Prior to that time about 530 pounds of commercial fertilizer per acre were applied in the year of the hoed crop, whereas the later application is equivalent to about 1600 pounds of commercial fertilizer per acre.

Table 59 shows that the plot applications are so arranged that treatments 1 and 2 give a comparison of nitrogen from two sources; treatments 3, 4, and 5 compare sources of phosphoric acid and treatment 6 receives no fertilizer, and has received none since the stable manure application in 1917. A closer examination of these comparisons will be made later in this section.

TABLE 59. GROUND LIMESTONE AND COMMERCIAL FERTILIZERS: FERTILIZERS OTHER THAN BORAX AND LIMESTONE APPLIED TO THE HOED CROPS

Treatment	Nitrate of soda, 15% N	Sulphate of ammonia, 20% N	Super-phosphate, 16% P_2O_5	Slag, 16% P_2O_5	Bonemeal, 20% P_2O_5	Muriate of potash, 50% K_2O
	lb.	lb.	lb.	lb.	lb.	lb.
1	420	—	450	450	—	202.4
2	—	315.0	450	450	—	202.4
3	210	157.5	900	—	—	202.4
4	210	157.5	—	900	—	202.4
5	150	112.5	—	—	720	202.4
6	—	—	—	—	—	—

The average of the annual yields of each main crop, and also the averaged totals for each fertilizer treatment, irrespective of the lime or borax treatments, are given in Table 60.

TABLE 60. GROUND LIMESTONE AND COMMERCIAL FERTILIZERS: AVERAGE YIELDS FOR EACH FERTILIZER TREATMENT

Treatment	Wheat, 12-year average (1918-43)	Clover hay, 13-year average (1916-43)	Mangels, 9-year average (1926-43)	Swede turnips, 5-year average (1938-43)
	bu.	tons	bu.	bu.
1	10.5	1.44	343.3	399.1
2	9.2	1.03	229.8	440.8
3	9.6	1.19	265.6	420.0
4	10.7	1.37	331.1	471.0
5	10.1	1.30	196.1	410.6
6	7.5	0.69	19.2	54.4
Averages of all treatments	9.6	1.16	230.8	366.0

The differences in the yields from the different sources of nitrogen and of phosphoric acid are outlined in Table 61.

TABLE 61. GROUND LIMESTONE AND COMMERCIAL FERTILIZERS: AVERAGE DIFFERENCES IN YIELDS FROM DIFFERENT SOURCES OF NITROGEN AND PHOSPHORUS, WITH AND WITHOUT LIME OR BORON

Difference between	Yields per acre							
	Wheat		Clover hay		Mangels		Swede turnips	
	Lime	No lime	Lime	No lime	Lime	No lime	Lime	No lime
	bu.	bu.	tons	tons	bu.	bu.	bu.	bu.
Nitrate of soda and sulphate of ammonia (Tr. 1 and 2)*	0.7	2.0	0.26	0.47	128.2	95.1	-69.3	8.2
Slag and superphosphate (Tr. 4 and 3)	1.4	0.8	0.07	0.29	36.7	76.1	30.7	82.1
Superphosphate and bonemeal (Tr. 3 and 5)	0.0	-1.0	-0.13	-0.07	48.3	90.3	22.7	-13.5
Slag and bonemeal (Tr. 4 and 5)	1.4	-0.2	-0.06	0.22	85.0	166.4	53.4	68.6
	Boron	No boron	Boron	No boron	Boron	No boron	Boron	No boron
Nitrate of soda and sulphate of ammonia (Tr. 1 and 2)	2.3	2.6	0.58	0.11	113.0	44.1	-26.3	-42.6
Slag and superphosphate (Tr. 4 and 3)	0.7	-0.4	0.04	0.04	114.3	58.3	42.2	59.7
Superphosphate and bonemeal (Tr. 3 and 5)	-1.5	0.1	-0.19	-0.08	26.0	60.0	-14.0	30.9
Slag and bonemeal (Tr. 4 and 5)	-0.8	-0.3	-0.13	-0.04	140.3	118.3	28.2	90.6

* See Table 59 for details of various treatments.

The effect of lime upon the reaction of turnips to nitrogenous fertilizers is striking. Where no lime was applied the turnips yielded more with nitrate of soda, but after the limestone application a better turnip yield was obtained with sulphate of ammonia. Most of the differences appear little affected by the borax treatment.

EFFECT OF LIMESTONE AND BORAX UPON DISEASE INCIDENCE IN MANGELS

When mangels were first grown on the experimental area in 1926, and for several years thereafter a disease was observed affecting the young seedlings and later the crown of the plants. This disease was identified in 1929 as *Phoma betae* (Oud.) Frank, and is usually known as heart-rot or crown-rot.

In order to determine whether this disease was aggravated by deficiencies of "trace elements" in the soil, a corollary test of five chemical elements was carried out in 1935 on soil at the south end of the main trial, where lime on two ranges and no lime on two others had been applied as in the main trial. Prior to 1935, and apart from the treatment up to 1923 with limestone, this land had received a uniform application of a complete fertilizer every three years.

Sulphates of magnesium, manganese, copper and zinc, and sodium tetraborate as a source of boron, were applied in addition to a complete fertilizer, as in treatment 1 of the main trial. The results showed there was no effect on the heart-rot except in the case of the sodium tetraborate application, which practically eliminated it, and the heart-rot was generally more severe on the areas receiving limestone.

The next year that mangels were grown on the main experimental area, in 1938, at which time boron was first applied to part of that area, no significant decrease in the infection was noted over that found in the no-boron plots. The average infection was only 12 per cent however, and since that time practically no heart-rot has appeared, so no additional records showing the effect of boron on the incidence of this disease are available.

TURNIPS

Turnips were first grown on the main trial in 1938. The records from that year on, showing the effect of the limestone and borax applications upon the brown-heart disorder of turnips, are shown in Tables 62 and 63.

TABLE 62. GROUND LIMESTONE AND COMMERCIAL FERTILIZERS: EFFECT OF LIME ON BROWN-HEART IN SWEDE TURNIPS

TreatmentX	Percentage of brown-heart on limed areas					Percentage of brown-heart on areas not limed				
	1938	1939	1940	1942	1943	1938	1939	1940	1942	1943
	%	%	%	%	%	%	%	%	%	%
1	35.0	38.8	51.5	51.3	30.0	22.5	46.3	51.8	53.8	50.8
2	27.5	42.5	50.0	56.3	37.5	12.5	38.8	41.5	48.8	50.0
3	26.3	40.0	50.0	48.8	25.0	27.5	46.3	44.8	51.3	52.5
4	22.5	51.3	46.8	56.3	22.5	26.3	42.5	59.8	56.3	52.5
5	26.3	51.3	51.0	53.8	48.8	32.5	48.8	50.0	51.3	50.0
6	25.0	00.0	00.0	00.0	00.0	7.5	00.0	00.0	00.0	00.0
Averages of fertilizer treatments	27.1	44.8*	49.9*	53.3*	32.8*	21.5	44.5*	49.6*	52.3*	51.0*

* Computed by dividing total by 5, instead of 6.
X See Table 59 for details of various treatments.

TABLE 63. GROUND LIMESTONE AND COMMERCIAL FERTILIZERS: EFFECT OF BORAX ON BROWN-HEART IN SWEDE TURNIPS

Treatment	Percentage of brown-heart on area receiving borax					Percentage of brown-heart on area not receiving borax				
	1938	1939	1940	1942	1943	1938	1939	1940	1942	1943
	%	%	%	%	%	%	%	%	%	%
1	2.5	0.0	3.3	7.5	3.3	55.0	85.0	100.0	97.5	70.0
2	0.0	0.0	0.0	10.0	1.7	40.0	81.3	91.5	95.0	81.7
3	2.5	0.0	3.3	7.5	5.0	51.3	86.3	91.5	92.5	63.3
4	0.0	5.0	9.8	15.0	1.7	48.8	88.8	96.8	97.5	63.3
5	0.0	8.8	1.0	5.0	3.3	58.8	91.3	100.0	100.0	95.0
6	0.0	0.0	0.0	0.0	0.0	32.5	0.0	0.0	0.0	0.0
Average of fertilizer treatments	1.0	2.8*	3.5*	9.0*	3.0*	47.7	86.5*	96.0*	96.5*	74.7*

*Computed by dividing total by 5 instead of 6.

It will be seen that ground limestone had no apparent effect upon the disorder but that the borax almost entirely controlled it. The infection in the borax-treated areas gradually increased, as also in the no-borax areas, but in the former the roots affected showed only a very slight amount of browning, whereas on the no-borax plots the roots were largely worthless, and indeed many of them, while appearing sound on the outside, were hollow or filled with soft decayed pulp.

CONCLUSIONS

One of the most marked features of the results here recorded is the generally low yield. For example, average annual yields per acre of 9.5 bushels of wheat 230.8 bushels of mangels, or 366.0 bushels of turnips, are actually very low and would be considered definitely unprofitable for any commercial enterprise. On the other hand, it must be remembered that the land has had only one application of barnyard manure, and has been steadily cropped for twenty-six years since manure was applied. In spite of the low yileds, however, the trial has adequately demonstrated the benefits of adding ground limestone to the soil. This is true of all crops grown on the area except swede turnips and potatoes. The latter became so badly infected with potato scab on the limed areas that, in spite of somewhat increased yields, the product was unmarketable, and the crop was discontinued in 1923. An

important aspect of the lime effect is its duration, for the effect was still clearly demonstrated in 1943, twenty-one years after the last application. An interesting interaction develops in turnip yields with sulphate of ammonia as the nitrogen source, and also where basic slag was the phosphoric acid source, for in these cases relatively large differences were shown to discredit the use of borax. However, it has been demonstrated that where boron deficiency is shown by the appearance of brown-heart in turnips, it is extremely desirable to apply borax and the disease may be effectively controlled by this means.

The turnip yields recorded in Table 60 indicate that on poor land, and land requiring limestone, turnips would be a much safer crop to grow than mangels. This is reflected in the general practice on Nova Scotia farms, where the areas devoted to growing swede turnips for stock feed are much in excess of the mangel plantings.

In Table 61 the general increase in fertilizer differences where no lime has been applied further indicates the benefits of lime.

In general, nitrate of soda has given better results than sulphate of ammonia, except in the case of turnips on limed soil. As for the three sources of phosphoric acid, bonemeal shows up as better than superphosphate on turnips, though the differences are not great. On the whole, there are no marked differences between the phosphate fertilizers on wheat and clover, but on the root crops the slag has proved definitely superior to both superphosphate and bonemeal. It is doubtful if this difference in favour of slag is sufficient to warrant its use where there is a price difference in favour of superphosphate.

It would seem that a somewhat heavier application of commercial fertilizers should be applied in practice, or better, some way of increasing the supply of organic matter in the soil should be used. Manure or clover ploughed under, or some green-manure crop, such as buckwheat or rye, might be beneficial.

Experiment With Boron

(J. S. Leefe)

Tests with borax as a source of boron have been made on a number of crops during the past ten years. These were made on apples, vegetables and field crops. The work with apples is given in this report under "tree fruits".

VEGETABLE CROPS

Experiments with boron were conducted in 1939 on a small scale which consisted of treated and untreated strips running across the vegetable garden variety tests. The tests covered the following vegetables, in most cases several varieties of each: bean, beet, cabbage, carrot, cauliflower, celery, corn, cucumber, eggplant, lettuce, onion, parsnip, pea, pepper, potato, pumpkin, soybean, squash, tomato, turnip. The garden area where the tests were conducted had not shown any previous recognizable symptoms of boron deficiency in vegetables except for slight brown-heart in swede turnips. The tests were partly to determine tolerance to boron applications, and partly to determine if there existed any previously unrecognized boron deficiency. Borax was applied in early spring at the rate of 20 pounds per acre. The great majority of vegetables showed no effect from the borax application. The application of borax controlled a moderate outbreak of brown-heart. With respect to beans and peas, the borax showed a toxic effect. The only bean variety under test was Early Yellow Eye. The foliage was paler during the early season on the treated areas and the yield at harvest was lower.

All varieties of peas were adversely affected by the borax. The yields of Fenland Wonder, Early Harvest and Gradawax were reduced by 60 per cent. Other varieties in the test were not so severely affected.

Vegetables planted in the same area in 1940 showed no visible ill effects from the borax, so it is concluded that the effect did not carry over to the following year.

FIELD CROPS

Tests of boron effect with field crops, begun in 1936, consisted essentially of four 3-year rotations. Unfortunately, this test had to be discontinued in 1940 so that the information on the durational effect of boron is of necessity limited. The four rotations were as follows: (a) swedes, oats, clover; (b) mangels, oats, clover; (c) potatoes, oats, clover; (d) grain*, potatoes, grain.

Borax was applied at 10, 20, 30 and 40 pounds per acre, both broadcast and in the row with the seed. An application was also made at 60 pounds broadcast. In addition three plots received 20, 40 and 60 pounds per acre broadcast, in the first year, to which no further applications were to be made. All applications were made to the first crop in the rotation.

The results at the end of three full years may be summarized as follows. All treatments were effective in reducing the incidence of brown-heart in turnips. Twenty pounds of borax per acre applied broadcast gave 95 per cent control. Yields were not affected.

Mangel yields were increased but there was no benefit from increasing the rate above 20 pounds per acre broadcast. This rate gave an increase of 200 bushels per acre; i.e., from 840 to 1040 bushels.

The yield of potatoes was not affected by the boron used, whether the borax was applied to the potato crop, or where potatoes followed grain.

The boron, when used at 30 pounds per acre broadcast or 20 pounds per acre drilled in with the seed, increased the yield of oats from 55 to 70 bushels per acre. Barley and wheat yields were not affected.

Grain and hay crops following potatoes, mangels or turnips were not affected by the application of borax made to the root crops.

In 1939, the first and only year of the second rotation for which records are available, all turnip plots which received borax were virtually free of brown-heart. This includes the three plots to which no repeat applications were made in 1939.

None of the other crops responded to applications of borax in this year. This is probably due to lack of moisture during the latter part of the growing season.

These tests indicate that applications of twenty to thirty pounds of borax per acre will control brown-heart in swedes and give increases in the yields of mangels and oats. There was no benefit to the other crops in the test, nor did the borax appear to be toxic at the highest rate used.

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* One-third each plot, oats, barley, wheat.

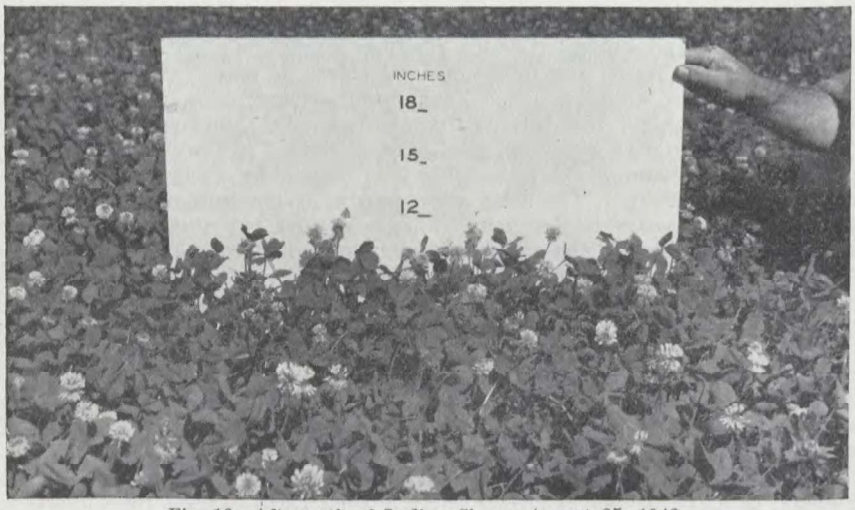

Fig. 16—Aftermath of Ladino Clover, August 25, 1942.

Experiments with Selective Weed Killers

(J. S. Leefe)

Tests with selective weed killers were begun at this Station in 1945 and are still in progress. Tests made in 1945 and 1946 were of a limited nature, largely because of scarcity of material.

Two main classes of materials are involved in this work: derivatives of 2, 4-dichlorphenoxy-acetic acid commonly referred to as "2, 4-D", and materials classified generally as "dinitros". While much additional testing with these materials remains to be done results to date indicate that these selective weed killers can now be safely used to practical advantage by farmers, particularly in the reduction of cadlock *(Raphanus raphanistrum)* in the grain crop.

OATS

Work in 1945 and 1946 indicated that spraying with various formulations of 2, 4-D and one dinitro compound would give good control of cadlock in oats, would not injure the grain and would give increased yields. At the strength used, 2, 4-D did severe damage to new-seeded clover. The dinitro compounds did not damage the clover seedlings.

In 1947, a test was made using three formulations of 2, 4-D at four different strengths, together with two dinitro compounds at one strength of application each. Plots were one square rod in area, and liquid was applied at 100 gallons per acre, on June 25. The results of the test are given in Table 64. With respect to 2, 4-D the actual amount of 2, 4-D acid used, per acre, is given. Since the many brands of this material differ considerably in concentration of active ingredient, this is the only practical method of measuring the amount of material to use.

TABLE 64. SELECTIVE WEED KILLERS: EFFECT ON CADLOCK IN OATS SEEDED DOWN

Material used and trade name	Quantity used per acre	Per cent of cadlock tops injured or killed	Stand of red clover at Oct. 10	Yield of grain per acre
	lb.	%	%	bu.
"Naugatuck" (amine salt of 2, 4-D)....	1/10	65	100	40.5
	1/4	100	100	32.5
	1/2	100	75	30.6
	1	100	30	29.5
"Dow G 654" (methyl ester of 2, 4-D)...	1/10	70	100	40.5
	1/4	100	60	41.7
	1/2	100	30	41.7
	1	100	5	35.7
"2, 4 Dow Weed Killer" (70% sodium salt of 2, 4-D).....	1/10	80	100	40.9
	1/4	90	100	37.6
	1/2	95	100	39.5
	1	100	100	43.3
"Sinox" (Dinitro amyl phenol).....	3 pints of 30% concentrate	10	100	33.0
"Dows Selective Herbicide" (Ammonium dinitro butyl phenate).....	3 pints of 30% concentrate	100	100	40.0
Not sprayed.....	—	Nil	100	24.5

From Table 64 it is evident that 2, 4-D at one-quarter pound per acre gave adequate control of cadlock. Dow's Selective Herbicide also gave adequate control of cadlock when used at the rate of 3 pints of 30 per cent concentrate per acre. The three formulations of 2, 4-D differed somewhat in their effect on the red clover seedlings. The sodium salt is the least harmful of the types used and the methyl ester the most harmful. The dinitro compounds did not injure the clover seedlings. All sprayed plots gave a greater grain yield than the unsprayed plot.

The accompanying photographs indicate the cadlock-killing effect of the various materials.

Figs. 17-21 — Effect of herbicide sprays on cadlock in oats. (All applied at rate of 100 gallons of solution per acre.) (17) – Amine salt of 2,4-D, ¼ lb. per ac.; (18) – Methyl ester of 2.4-D, ¼ lb. per ac.; (19) – 70% sodium salt of 2,4-D, ¼ lb. per ac.; (20) – Dow's selective herbicide, 3 pints of 30% concentrate per ac.; and (21) – Not sprayed.

FIELD PEAS

Preliminary tests in the greenhouse with Dow's Selective Herbicide indicated this material would kill cadlock and not injure young pea plants. All 2,4-D formulations tried caused severe injury to the pea plants. Field trials were conducted in 1947.

The field used consisted of about six acres of peas being grown for commercial canning. Plots were one square rod in area, and 100 gallons of solution was applied per acre. The results are shown in Table 65.

TABLE 65. DOW'S SELECTIVE HERBICIDE FOR PEAS

Plot	Rate of application	Per cent kill of cadlock	Yield per acre of shelled peas
		%	lb.
1	6 pints 30% concentrate	100	720
2	3 pints 30% concentrate	100	560
3	1½ pints 30% concentrate	90	340
4	¾ pints 30% concentrate	Nil	Nil
5	Not sprayed	Nil	Nil

At the time of spraying, the cadlock was dense, almost hiding the peas. The 3-pint-per-acre rate caused slight injury and the 6-pint rate, severe injury, noticeable on examination twenty days after spraying. The yields indicate that the spray injury is negligible when compared with the effect of weed competition.

Later in the season a large-scale test was made. A band 30 feet wide extending across the field was sprayed with a power sprayer, using a 10-foot boom. One hundred gallons per acre of solution was applied, using 2 pints of herbicide per 100 gallons. The cadlock was 18 inches high and in full bloom at the time of spraying.

The cadlock was killed and the sprayed portion of the field yielded 1500 pounds of peas per acre. The unsprayed portion was not worth harvesting.

In addition to its ability to kill cadlock it was noticed that the herbicide also killed large numbers of pea aphids. Counts made of aphids showed that the average population per plant dropped between July 21 and July 31 from 17 to 3 on the sprayed portion of the field. The average population per plant on the unsprayed portion increased from 19 to 31 in the same period. It seems likely that part of the increase in yield on the sprayed portion of the field was due to the control of the aphids.

Studies in Fertilized Pastures

(A. Kelsall)

HISTORY OF THE FIELD

The land used in the Kentville experiments on fertilized pastures was first broken in 1919 and 1920, being seeded to timothy and clover in August, 1920. Previous to seeding it was given a dressing of ten tons of manure and 600 pounds of complete fertilizer per acre. Hay crops were taken from 1921 to 1924, and the area was pastured from 1925 to 1930. In 1931 the land was in a run-down condition, and mostly occupied by weeds and moss. In 1931 a portion of the area was taken for preliminary experiments with top-dressings of fertilizer, and this work continued until 1934. In the light of this experience, plots were laid out in 1935, and these have been under continuous treatment with the same materials since that time. Later, notably in 1941, the remaining part of the area was laid out in plots.

CHARACTERISTICS OF THE FIELD

The field is reasonably uniform throughout. The soil is relatively infertile. The surface is somewhat rough, never having been ploughed or harrowed sufficiently to remove the natural "cradle hills" characteristic of the forest from which it was broken.

The total area involved is twelve acres, and the soil throughout is Berwick sandy loam.

The pH values of the surface soil, taken in 1945, vary considerably throughout the field, from 5.49 to 6.97. However, most of the area has soil in the range of pH values 5.6 and 6.2. The percentage of organic matter in the soil varies from 4.5 to 8.5, with most of the surface soil in the area approximating 5 per cent.

PROCEDURE

In this project the area designated "old fields" relates to those fields under continuous treatment since 1935, and "new fields" those under continuous treatment since 1941. In all cases, fertilizer was applied as early in the spring as the land permitted. The nutrient ingredients were based on nitrate of soda, superphosphate and muriate of potash, with the exception that in the last two years of the period under review (1945 and 1946) an equivalent in the form of ammonium nitrate was, of necessity, substituted for nitrate of soda. The costs of treatment are based on fertilizer prices generally prevailing up to a few years ago.

The field was divided into seven plots of one acre each, and twenty plots of one-fifth acre each. The acre plots are pastured in rotation, and the twenty-fifth-acre plots are pastured as one field.

Three methods of evaluating the results were used. In the case of the acre plots, records of the number of animal-days of grazing were kept. This procedure, however, was found to be quite unreliable due to the preference of the animals for certain types of herbage. The animals grazed reluctantly on some fields and voraciously on others.

Records were also kept of the green weight or dry weight of the herbage on the various plots. This was done by maintaining three cages, each of one square yard, in each plot. The grass under these cages was clipped at suitable intervals, and each time this was done the cages were shifted at random to newly-prepared locations. Also in some years with the co-operation of the Chemistry Division, moisture, ash and protein determinations were made on all plots at each time of clipping.

TREATMENT DOSAGE

The treatments and dosages were as follows:

N_1 = 100 pounds nitrate of soda every year.
N_3 = 300 pounds nitrate of soda every year.
P_1 = 600 pounds superphosphate every third year.
P_3 = 600 pounds superphosphate every year.
K_1 = 100 pounds muriate of potash every third year.
K_3 = 100 pounds muriate of potash every year.
O = No treatment.

TABLE 66. STUDIES IN FERTILIZED PASTURES: TEN-YEAR AVERAGE YIELD OF HERBAGE ON OLD FIELDS

Treatment	Average yield	Average increase over check	Annual cost per ton of increase
	lb.	lb.	$
$N_1P_1K_1$	15,515	12,465	0.76
O	3,050	—	—
P_1	9,376	6,326	0.63
P_1K_1	13,933	10.883	0.50

TABLE 67. STUDIES IN FERTILIZED PASTURES: SIX-YEAR AVERAGE YIELD OF HERBAGE ON OLD AND NEW FIELDS

Treatment		Average yield	Average increase over check	Annual cost per ton of increase
		lb.	lb.	$
$N_1P_1K_1$	1 acre each	14,910	12,257	0.77
O	1 acre each	2,730	—	—
P_1	1 acre each	10,232	7,579	0.53
P_1K_1	1 acre each	14,211	11,558	0.47
$N_1P_3K_3$	1 acre each	25,958	23,305	0.87
$N_3P_1K_1$	1 acre each	16,975	14,322	1.22
$N_3P_3K_3$	1 acre each	23,326	20,673	1.37
P_1	1/5 acre each	7,336	4,683	0.85
P_1K_1	1/5 acre each	10,235	7,582	0.72
P_3K_3	1/5 acre each	11,777	9,124	1.80
P_3	1/5 acre each	8,695	6,042	1.99
O	1/5 acre each	3,294	—	—
N_1	1/5 acre each	5,751	3,098	1.29
K_1	1/5 acre each	2,808	155	9.42
K_3	1/5 acre each	3,939	1,286	3.42
N_3	1/5 acre each	9,730	7,077	1.70
O	1/5 acre each	1,936	—	—

Tables 66 and 67 are for the most part self-explanatory and illustrate the following points:

(1) While all the individual nutrient elements increased the yields, the response was greatest from phosphorus.

(2) Pronounced responses were obtained from nitrogen and potash, but only when used in combination with phosphorus.

(3) Increasing the dosage of minerals from the P_1K_1 to the P_3K_3 level only slightly increased the yields. (The duplicate mineral plots in the one-fifth-acre series yielded somewhat less than the original ones in the acre series, but the groups showing the smaller yields are contiguous, at slightly higher elevation and somewhat more affected by drouth).

(4) Increasing the dosage of minerals from the P_1K_1 to the P_3K_3 level, when used in conjunction with nitrogen, resulted in very pronounced increases.

(5) From the standpoint of yield, a definite advantage was obtained in increasing nitrogen from the N_1 to the N_3 level when used in conjunction with minerals at the low level, but there was no advantage when used with minerals at the high level.

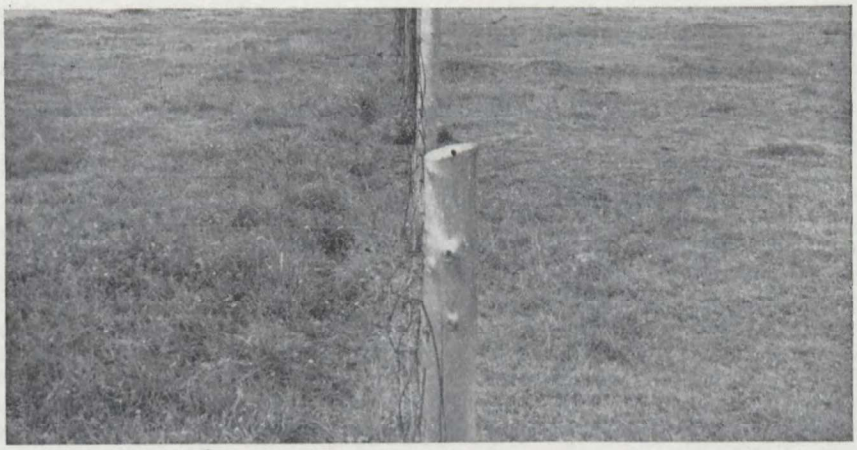

Fig. 22—Fertilized Pasture Plots (left, NPK treatment; right, no treatment).

(6) The cost of fertilizer per ton of increased herbage is obviously lowest on the P_1K_1 treatments; that is, the minerals alone at the low dosage. Phosphorus alone, at the low dosage, produced increased yields at a very low figure. With respect to the complete fertilizers, while the cost per ton is somewhat higher, it must be considered low in relation to economic returns. The $N_1P_3K_3$ treatment, a very high dosage, produced increased herbage at a cost of 87 cents per ton. The $N_3P_3K_3$ treatment is considerably higher in cost per ton than the former, but might be economical for certain purposes.

BOTANICAL COMPOSITION OF HERBAGE

During the period under review, an herbage analysis was made of various plots. That of 1945, showing only the prevalent species, is given in Table 68.

TABLE 68. STUDIES IN FERTILIZED PASTURES: PERCENTAGE GROUND COVERAGE ON EACH FIELD, 1945

	$N_1P_1K_1$	0	P_1	P_1K_1	$N_1P_3K_3$	$N_3P_1K_1$	$N_3P_3K_3$
	%	%	%	%	%	%	%
Bare ground	11	11	21	15	14	31	24
Mosses	3	36	4	5	—	1	—
Herbage cover	86	53	75	80	86	68	76
Kentucky blue grass	34	2	28	25	44	41	38
Brown top	14	26	22	23	13	16	17
White clover	34	2	15	28	25	8	16
Valuable forage (grass and clover)	82	30	65	74	82	65	71

The area listed as bare ground is mostly, though not entirely, due to deposits of manure either of the current or preceding year. Mosses covered 36 per cent of the no-treatment area, and were comparatively insignificant on all others. Kentucky blue grass and white clover constituted a large part of the herbage of all the treated plots, but were nearly absent in the no-treatment area. Kentucky blue grass was greatest in amount on those plots receiving a complete fertilizer, and brown top was the least.

The addition of potash to phosphorus increased the stand of white clover. White clover was more prevalent in the plot receiving P_1K_1, and in the complete fertilizers low in nitrogen. It was least prevalent in the complete fertilizers high in nitrogen.

The complete fertilizers low in nitrogen had the highest percentage of valuable forage.

A matter of interest, not shown in Table 68, is the number of species found in the various plots. In general, the larger the fertilizer dosage, particularly that of complete fertilizer, the fewer the number of species present. For example, in the no-treatment area 53 species were identified, whereas in the $N_1P_3K_3$ area only 20 species were found.

In the botanical composition of these plots, there is some variation from year to year, presumably mostly due to climatic conditions. For example, in some seasons white clover is more prevalent throughout than in others. However, after making due allowance for such variations, it may be said that areas treated with certain specific fertilizers in the course of a few years come to an equilibrium; that is, a more or less fixed relationship between the treatment and the species of plants present.

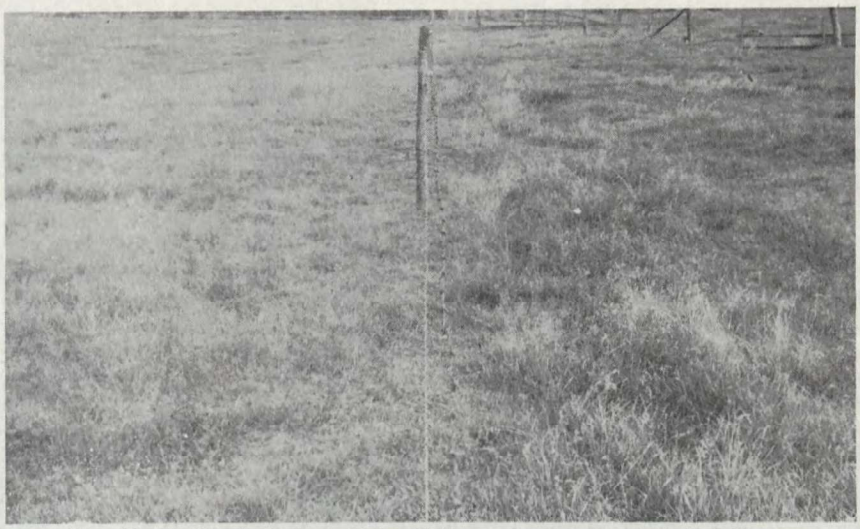

Fig. 23—Fertilized Pasture Plots (left, no treatment; right $N_3P_3K_3$).

The lapse of time taken to change the character of the herbage materially is a matter of interest. In 1941 two plots in the no-treatment area were treated with $N_3P_3K_3$. Fourteen months after treatment an analysis of the herbage on these plots was made, the results being shown in Table 69. For purposes of comparison there is also included an adjoining plot which had been continuously treated with $N_1P_1K_1$ for a period of years.

TABLE 69. STUDIES IN FERTILIZED PASTURES: SUMMARY OF SWARD COMPONENTS, JUNE, 1942, SHOWING PERCENTAGES OF BARE GROUND AND FIVE PREVALENT SPECIES

	Treatment			
	$N_1P_1K_1$	O	$N_3P_3K_3$	$N_3P_3K_3$
	%	%	%	%
Bare ground	6.9	31.5	6.4	7.4
Poa pratensis (Kentucky blue)	40.4	0.3	17.7	18.5
Agrostis tenuis (Brown top)	20.9	17.1	17.1	24.4
Trifolium repens (White clover)	20.0	0.9	22.1	26.6
Anthoxanthum odor (Sweet vernal)	4.9	12.9	23.4	14.5
Danthonia (Wire grass)	0.0	12.1	0.0	0.3
Total number of species present	23	53	38	26

The striking change in the composition of the herbage within a period of fourteen months of this heavy application of fertilizer stands out clearly in Table 69. Both Kentucky blue grass and white clover had become well established, and the undesirable type of herbage had in a large measure disappeared. These treated areas were, within fourteen months, in a transitional stage from one type of herbage to another, but with the change well towards completion. While these results were obtained on the areas under consideration, there were other areas reported where such transition was slower or even did not take place at all. While all the factors which may be involved are not known, perhaps such a transition can only take place rapidly if there are some of the plants concerned either in the original sod or in the near vicinity.

PROTEIN CONTENT OF HERBAGE

A complete analysis of the records dealing with the protein content of the herbage on the various plots, and at various periods during the season, is beyond the scope of this summary. However, Table 70 shows the average protein content of the herbage for 1946, on both a green-weight and dry-weight basis; the pounds of protein produced per acre in 1946, and for comparative purposes, the pounds of protein produced per acre in 1945.

TABLE 70. STUDIES IN FERTILIZED PASTURES: PROTEIN CONTENT OF THE HERBAGE

Treatment	Per cent protein, green weight, 1946	Per cent protein, dry weight, 1946	Protein per acre	
			1946	1945
	%	%	lb.	lb.
$N_1P_1K_1$	4.6	18.7	460.6	501.4
O	1.9	9.7	18.0	63.5
P_1	4.0	16.4	288.7	391.5
P_1K_1	4.0	19.5	580.0	783.5
$N_1P_2K_3$	4.4	21.9	881.3	933.8
$N_2P_1K_1$	3.9	17.5	380.5	643.3
$N_2P_2K_3$	4.0	20.0	642.4	1,054.1
P_1	3.3	18.4	171.1	246.2
P_1K_1	4.0	21.5	320.0	306.5
P_2K_3	3.9	22.0	356.2	410.4
P_3	3.8	21.2	240.9	267.6
O	1.3	11.7	14.2	29.8
N_1	2.3	14.0	90.8	137.9
K_1	2.3	10.3	36.5	40.3
K_3	2.6	11.8	33.8	48.0
N_3	4.5	17.7	290.6	257.9
O	1.0	10.8	11.6	122.9

It will be seen from the figures presented, relating to one year, and in part to two years, that it is not desirable to draw any detailed conclusions. However, the wide differences in the pounds of protein produced on the no-treatment areas and on the plots of the better fertilizer treatments is so pronounced that it might be truly characterized as amazing. If protein production can be regarded as a suitable yardstick for measuring nutritive value, then the case for the fertilizing of pastures on this type of land becomes convincing.

ECONOMIC CONSIDERATIONS

So far, matters pertaining to production and costs have been under consideration, but there remain other important factors. The treatments which produce suitable herbage at the lowest cost per ton, or at the highest yield per acre, are not necessarily the ones to adopt for a farmer's particular economic circumstances. Factors which enter into consideration are the yield of herbage per acre which the particular farmer desires in order to suit his circumstances. Some have more land available for pasture purposes in relation to number of animals than others. Also, the cost of obtaining each ton of increased herbage must be considered, as well as the length of pasture season and the continuity of production.

The length and continuity of production of a pasture is very important, and a farmer might consider it to be more economical to produce herbage at a somewhat higher cost per ton if by doing so he could be assured of a longer pasture season. To study this matter further it is necessary to consider some of the characteristics of the various plots. While no figures will be given, the following are pertinent points.

(1) The no-treatment areas produce little herbage except during the month of June.

(2) While the minerals alone produce a fair yield of herbage, and at a very low cost per ton, the pasture season is short, as the herbage is slow in starting in the spring.

(3) Complete fertilizers with nitrogen at the N_1 level produce herbage earlier than the minerals alone, and the $N_1P_3K_3$ plot produces herbage throughout the pasture season more evenly than any other.

(4) While complete fertilizer with nitrogen at the N_3 level produces herbage at a higher cost per ton, and (largely due to less white clover) is not so sustaining in the late season of pasture, nevertheless this type of fertilizer produces herbage in the spring much earlier than any other. This varies in different seasons from a few days to as much as a month. At this Station, the presence of two acres treated with this type of material, out of a total of twelve acres, has, since these fields were set up, permitted the pasturing of cattle to be commenced on an average of seven days earlier than in previous years. This is an important consideration.

On the basis of the experiments, and considering the mixed fertilizers available in Nova Scotia, the farmer with a small pasture, or one who wishes to avoid complexities, would undoubtedly be well advised to use the fertilizer formula 3-15-6 in dosage varying between 300 and 800 pounds per acre, depending upon the yield desired. For farmers who desire to make the best possible use of fertilizers, another method of approach is suggested. Since it has been shown that no single fertilizer formula will produce all the results desired, it then becomes necessary to divide the pasture into sections each treated with an appropriate formula.

This can perhaps be better explained by taking a hypothetical example, based on the presumption of the soils reacting to fertilizers in a way similar to that described. Suppose that a farmer has ten acres available for pasture and that he desires this to produce an average yield of 18,000 pounds of green herbage per acre, what treatments would be advantageous?

This man could achieve his yield objective to the best advantage by treating annually five acres with 200 pounds superphosphate and 34 pounds muriate of potash per acre, three acres with 50 pounds ammonium nitrate, 600 pounds superphosphate and 100 pounds muriate of potash per acre, and two acres with 150 pounds ammonium nitrate, 200 pounds superphosphate and 34 pounds potash per acre.

The overall yield on this ten acres would be 180,000 pounds herbage, produced at an overall cost of 77 cents per ton, green weight. The length of grazing season would be at a maximum.

Open-hearth Steam-granulated Tapping Slag

(A. Kelsall and J. S. Leefe)

As a by-product in the production of steel there has long existed a large quantity of waste slag containing both phosphoric acid and lime. Preliminary tests with this material as a fertilizer for plants revealed that it was valuable mostly for its lime content and its ability to reduce the acidity of the soil, but that the phosphoric acid was in a form relatively unavailable to plants.

The problem, therefore, was to find ways and means of utilizing this otherwise waste material as a fertilizer. The type of work involved many lines of endeavour: physical, chemical, agricultural, and manufacturing-plant technique. A committee was convened by the Minister of Agriculture for Nova Scotia, and the work was co-ordinated by the committee under the chairmanship of Dr. George R. Smith, Provincial Chemist, N. S. Agricultural College, Truro. The personnel of the committee were as follows:

F. E. Lathe, National Research Council, Ottawa.
Dr. A. E. Cameron, Deputy Minister of Mines for Nova Scotia, Halifax.
Dr. Norman A. Parlee, Dominion Steel and Coal Corporation, Sydney.
Professor A. E. Flynn, Nova Scotia Technical College, Halifax, N.S.
Professor Angus Banting, Agricultural Engineer, N. S. Agricultural College, Truro, N.S.

Kenneth Cox, Provincial Agronomist, Truro, N.S.
Dr. G. R. Smith, Provincial Chemist, Truro, N.S.
W. W. Baird, Superintendent, Experimental Station, Nappan, N.S.
A. Kelsall, Superintendent, Experimental Station, Kentville, N.S.

As its share in the work of this committee, the Kentville Station was to undertake some of the work in assessing the value of the different types of slags produced by various processes and modifications of plant technique.

Of the slags available, the tapping slag is the most abundant, and this slag was found early to have a relatively high available-phosphorus content if cooled rapidly after removal from the open-hearth furnace. For the purposes of this summary, therefore, the data which follow relate only to representative field and greenhouse experiments made in order to determine the agricultural value of this particular type of slag, which is termed open-hearth steam-granulated tapping slag.

While there were slight variations in the chemical analysis of the material used in the various experiments, for the most part the material contained approximately 9 per cent total phosphoric acid, 4½ per cent citric-soluble phosphoric acid and a calcium oxide content in terms of ground limestone roughly equivalent to 75 per cent of its weight.

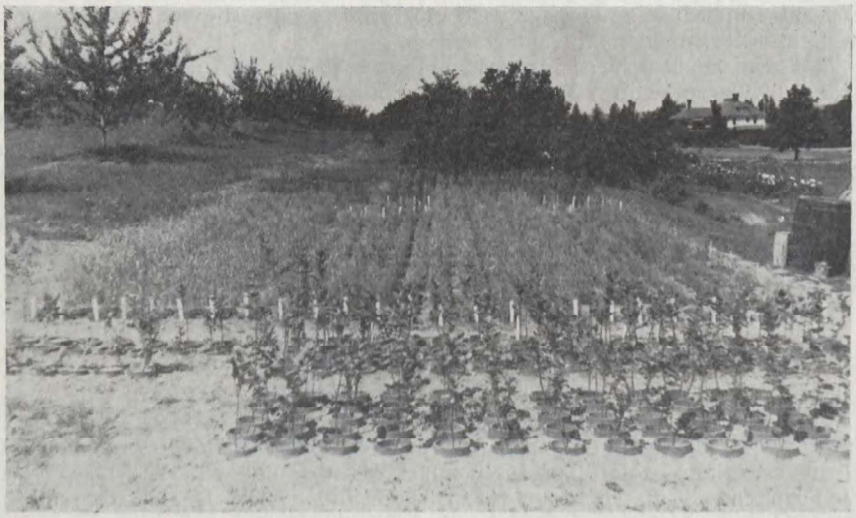

Fig. 24—Pot Experiments with Fertilizers on Soils from Different Localities. (Experimental Station, Kentville, N.S., 1942).

Greenhouse Experiments

Effect of Slag on Eight Soil Types

Eight quite widely differing soils were used, these in each case being collected from a location which either had never before received fertilizer treatment or had not received such treatment for many years. Six-inch pots were used, with duplicate plots for each soil and treatment. The crop grown was barley, and the yields were taken as green weight, after heading, while the plants were still in the green stage. The test thus shows only the immediate and not the long-term effect of slag, and also pertains only to the particular plant, barley.

The pH values of the soils were taken through the co-operation of the Chemistry Division, Science Service, immediately after harvesting the crops.

In Tables 69, 70 and 71 below the term "5-0-5" for the purposes of this experiment means an application equivalent to 1000 pounds per acre of a mixture containing 5 per cent nitrogen, no phosphoric acid and 5 per cent potash, which provided nitrogen and potash at the rate of 50 pounds each per acre. These ingredients were in the forms of nitrate of soda and muriate of potash. The dosage of materials used is expressed in the tables in pounds per acre.

TABLE 71. OPEN-HEARTH STEAM-GRANULATED TAPPING SLAG: YIELDS ON SOILS WHICH RESPONDED TO LIMESTONE (GROUP 1)

Barley, green weight, grams per pot.

Treatment	A Truro		B Camden		E Westbrook		H Nappan Dyke	
	Yield	pH	Yield	pH	Yield	pH	Yield	pH
	gm.	value	gm.	value	gm.	value	gm.	value
1. Check	5.4	5.5	8.8	4.8	9.0	5.0	15.0	5.4
2. 5–0–5	12.9	5.5	10.9	5.0	12.8	5.2	35.6	5.6
3. 5–0–5 plus 500 lb. superphosphate	47.4	5.5	59.8	4.9	55.2	5.0	59.3	5.3
4. 5–0–5 plus 500 lb. superphosphate, plus 1,250 lb. limestone	52.9	6.3	69.7	5.6	68.2	5.9	62.6	5.8
5. 5–0–5 plus 500 lb. superphosphate, plus 2,500 lb. limestone	50.9	7.0	73.9	5.9	64.8	6.6	76.3	5.8
6. 5–0–5 plus 500 lb. superphosphate, plus 3,750 lb. limestone	66.6	6.8	78.7	6.5	76.4	6.9	63.6	5.7
7. 5–0–5 plus 500 lb. superphosphate, plus 5,000 lb. limestone	59.2	7.1	81.9	6.2	72.4	7.4	75.2	6.2
8. 5–0–5 plus 1,250 lb. slag	36.8	5.7	40.3	5.1	45.6	5.8	47.6	5.8
9. 5–0–5 plus 2,500 lb. slag	41.0	6.4	59.3	5.9	58.2	6.2	69.5	6.0
10. 5–0–5 plus 3,750 lb. slag	58.7	6.5	66.9	6.0	76.2	6.7	75.2	6.3
11. 5–0–5 plus 5,000 lb. slag	54.6	6.5	75.6	5.5	81.2	6.9	81.7	6.8

TABLE 72. OPEN-HEARTH STEAM-GRANULATED TAPPING SLAG: YIELDS ON SOILS WHICH DID NOT RESPOND TO LIMESTONE (GROUP 2)

Barley, green weight, grams per pot.

Treatment	C Queens		D Nappan		E Tormentine		G Pugwash	
	Yield	pH	Yield	pH	Yield	pH	Yield	pH
	gm.	value	gm.	value	gm.	value	gm.	value
1. Check	18.5	4.9	17.3	5.1	20.4	5.4	15.1	5.1
2. 5–0–5	30.3	5.2	34.5	5.2	36.9	5.5	24.7	5.4
3. 5–0–5 plus 500 lb. superphosphate	67.3	5.0	67.5	5.3	74.4	5.5	59.1	5.2
4. 5–0–5 plus 500 lb. superphosphate, plus 1,250 lb. limestone	69.4	5.4	69.8	5.9	76.7	5.8	56.7	5.8
5. 5–0–5 plus 500 lb. superphosphate, plus 2,500 lb. limestone	69.1	6.2	64.3	6.9	74.1	6.8	62.1	7.0
6. 5–0–5 plus 500 lb. superphosphate, plus 3,750 lb. limestone	64.3	6.4	58.9	6.7	72.1	7.1	68.4	7.2
7. 5–0–5 plus 500 lb. superphosphate, plus 5,000 lb. limestone	72.0	6.7	67.1	7.4	71.4	7.1	63.1	7.5
8. 5–0–5 plus 1,250 lb. slag	59.3	5.4	51.1	6.2	62.7	5.7	39.7	6.0
9. 5–0–5 plus 2,500 lb. slag	63.9	6.0	54.1	6.1	65.2	6.6	64.2	6.5
10. 5–0–5 plus 3,750 lb. slag	69.6	6.1	66.5	6.3	76.1	6.8	53.8	6.2
11. 5–0–5 plus 5,000 lb. slag	78.2	6.8	73.3	6.7	82.9	6.9	68.5	7.2

TABLE 73. OPEN-HEARTH STEAM-GRANULATED TAPPING SLAG: AVERAGE YIELDS OF GROUPS 1 AND 2

Barley, green weight, grams per pot.

Treatment	Average, Group 1		Average, Group 2	
	Yield	pH	Yield	pH
	gm.	value	gm.	value
1. Check	9.6	5.17	17.8	5.12
2. 5–0–5	18.1	5.32	31.6	5.32
3. 5–0–5 plus 500 lb. superphosphate	55.4	5.17	66.6	5.25
4. 5–0–5 plus 500 lb. superphosphate plus 1,250 lb. limestone	63.4	5.90	68.2	5.72
5. 5–0–5 plus 500 lb. superphosphate, plus 2,500 lb. limestone	66.5	6.32	67.4	6.72
6. 5–0–5 plus 500 lb. superphosphate, plus 3,750 lb. limestone	71.3	6.47	64.7	6.85
7. 5–0–5 plus 500 lb. superphosphate, plus 5,000 lb. limestone	72.2	6.72	68.4	7.17
8. 5–0–5 plus 1,250 lb. slag	42.6	5.60	53.2	5.82
9 5–0–5 plus 2,500 lb. slag	57.1	6.12	61.9	6.30
10. 5–0–5 plus 3,750 lb. slag	69.3	6.37	66.5	6.35
11. 5–0–5 plus 5,000 lb. slag	73.3	6.42	75.8	6.90

RESULTS

The results are expressed in terms of the average of the replicated plots; for the most part there was good agreement between replications. Some points of interest in the above results are:

(1) Of the eight soils under test, four gave a definite response to limestone and four did not.

(2) There appears to be no relationship between the original pH values of the soils and their response to limestone.

(3) In every case, on the untreated soil, the group of soils on which limestone had no effect gave a higher yield than the group of soils on which limestone was effective.

(4) On the group of soils which did not respond to limestone, approximately 3750 pounds of slag was equivalent in effect to 500 pounds of superphosphate.

(5) On the group of soils on which limestone was effective, the following represent approximate values:

2250 lb. slag = 500 lb. superphosphate.
3000 lb. slag = 500 lb. superphosphate + 1250 lb. limestone.
3400 lb. slag = 500 lb. superphosphate + 2500 lb. limestone.
4000 lb. slag = 500 lb. superphosphate + 3750 lb. limestone.
4600 lb. slag = 500 lb. superphosphate + 5000 lb. limestone.
5000 lb. slag = 500 lb. superphosphate + 6250 lb. limestone.

Changes in the pH values of the soils.

(a) The addition of 5-0-5 to the original soil slightly raised the pH values, probably due to the nitrate of soda.

(b) The addition of superphosphate to the 5-0-5 slightly lowered the pH values.

(c) 5000 pounds of slag is about the equivalent of 3750 pounds of limestone in its effect on the pH values of the soil.

EFFECT OF SLAG ON A SOIL AT VARYING MOISTURE LEVELS

In certain field experiments there had been the suggestion that slag showed up to better advantage than superphosphate plus limestone under conditions of high soil moisture, as compared with conditions of drouth. The following experiment, therefore, was set up to obtain more data on this point.

Kentville soil was used in this project; other details connected with the technique were the same as those described for the previous experiment, except that the plots were in triplicate.

The moisture levels maintained in the soils are represented by the arbitrary figures 200, 150, 100, 75, 50 and 25. The soils in the 200 series were at all times supplied with water to the limit of the holding capacity of the soil. Water was supplied to the other soils in the ratios designated by the corresponding figures. Thus the soils in the 25 series were under conditions of such extreme drouth that even the low yields obtained were quite surprising. See Table 74.

TABLE 74. EFFECT OF OPEN-HEARTH STEAM-GRANULATED TAPPING SLAG ON A SOIL AT DIFFERENT MOISTURE LEVELS: YIELDS OF BARLEY IN GRAMS OF GREEN WEIGHT PER POT

Treatment	Yield at Different Moisture Levels					
	200	150	100	75	50	25
	gms.	gms.	gms.	gms.	gms.	gms.
1. 5–0–5	26.0	27.7	26.2	16.1	10.5	5.7
2. 5–0–5 plus 500 lb. superphosphate	45.6	40.0	31.8	28.4	34.5	17.2
3. 5–0–5 plus 500 b. superphosphate, plus 2 tons limestone	57.6	56.6	48.6	43.1	36.5	23.7
4. 5–0–5 plus 2 tons slag	78.9	70.1	50.6	44.4	41.3	13.5

It will be noted from Table 74 that this soil responded markedly to phosphorus and to lime.

Under the moisture conditions represented by 200 and 150, 4000 pounds of slag produced about 40 per cent greater yield than did 500 pounds of superphosphate plus two tons of limestone. Under moisture conditions represented by 100, 75 and 50, 4000 pounds of slag gave slightly greater yields than 500 pounds of superphosphate plus two tons of limestone. Under conditions of extreme drouth, as represented by 25, the slag gave little more than half the yield of superphosphate plus lime, but even under this extreme drouth condition, the plants were utilizing slag to some extent, as evidenced by the much greater yield than the check.

Under conditions of excessive moisture as represented by 200, the pH value of the soil was apparently raised more by slag than by limestone. After the four treatments the pH values of the soil were as follows: (1) 5.30; (2) 5.03; (3) 6.00; (4) 6.99.

MASSIVE DOSAGES OF SLAG AND LIMESTONE

It had been suggested that certain ingredients in slag, such as fluorine, for example, might be toxic to plant growth if massive dosages were applied. This particular experiment was to procure data on this point. The technique was the same as in the previous experiment.

In this experiment the limestone and slag each were applied separately in dosages varying from 1250 pounds per acre to 100,000 pounds per acre.

TABLE 75. MASSIVE DOSAGES OF OPEN-HEARTH STEAM-GRANULATED TAPPING SLAG AND OF LIMESTONE: YIELDS OF BARLEY IN GRAMS OF GREEN WEIGHT PER POT

Dosage	Limestone		Slag	
	Yield	pH	Yield	pH
	gms.	value	gms.	value
5–0–5 + 1,250 lb. limestone or slag	43.7	5.6	53.5	5.7
5–0–5 + 2,500 lb. limestone or slag	39.1	6.7	63.6	6.5
5–0–5 + 5,000 lb. limestone or slag	57.4	6.8	76.7	6.8
5–0–5 + 10,000 lb. limestone or slag	55.9	7.0	104.2	7.8
5–0–5 + 50,000 lb. limestone or slag	103.8	7.8	169.8	8.3
5–0–5 + 100,000 lb. limestone or slag	106.7	7.7	127.1	8.6

Limestone in increasing dosages produced increased yields, and in massive dosages of 50,000 pounds and upwards increased the yields very materially.

Slag in increasing dosages gradually increased the yields, and in massive dosages increased the yields very considerably.

There was no sign of any toxic effect from any of the massive dosages. These plants were particularly rank and luxuriant.

With this soil, slag raised the pH values as much as limestone, and in the massive dosages the slag gave higher pH values.

FIELD EXPERIMENTS

The field experiments conducted at the Kentville Station were in triplicate plots, the results from which are averaged in the tables. There was considerable variation in yields among the replicates, probably because during the years of the test these plots suffered from the two extremes of excessive moisture and excessive drouth, with resultant unevenness of catch of seed and other uncontrollable variations. The area used was one of low fertility. The figures from this Station must, therefore, be regarded only as trends and must be considered in conjunction with the results obtained in similar experiments elsewhere.

The oats crop sown in 1945 was a virtual failure in all plots due to excessive moisture and very late sowing.

TABLE 76. OPEN-HEARTH STEAM-GRANULATED TAPPING SLAG: YIELDS OF FIELD CROPS PER ACRE

Treatment (Applied in 1944)	1944, Oats	1945, Clover
	bu.	tons
Check	29.6	1.31
Limestone, 2,000 lb.	33.5	1.76
Superphosphate, 500 lb.	28.5	1.82
Superphosphate, 500 lb. plus limestone, 2,000 lb.	31.8	1.88
Slag, 1,250 lb.	32.4	2.06
Slag, 1,250 lb. plus limestone, 2,000 lb.	33.5	2.09
Slag, 3,750 lb.	32.6	2.29
Slag 3,750 lb., plus limestone, 2,000 lb.	36.8	2.54

TABLE 77. OPEN-HEARTH STEAM-GRANULATED TAPPING SLAG: YIELDS OF FIELD CROPS PER ACRE

Treatment (Applied in 1944)	1944, Swedes	1945, Oats	1946, Clover Hay
	bu.	bu.	tons
Check	152	13.7	1.17
Limestone, 2,000 lb.	188	14.3	2.13
Superphosphate, 500 lb.	472	13.2	2.02
Superphosphate, 500 b., plus limestone, 2,000 lb.	520	17.2	2.11
Slag, 1,250 lb.	325	14.9	2.46
Slag, 1,250 lb., plus limestone, 2,000 lb.	399	15.5	2.13
Slag, 3,750 lb.	503	16.0	2.21
Slag, 3,750 lb., plus limestone, 2,000 lb.	495	17.7	3.19

In the case of the swedes sown in 1944, there was good agreement between the replicated plots, and the figures obtained may be regarded as an accurate reflection of the results of the initial year of treatment on that particular crop. The slag appeared to have little effect on oats in the initial year of treatment. The residual effects of the slag gave considerable increases in the yields of clover hay.

OTHER FIELD EXPERIMENTS

Several other types of field experiments are in progress, including ones connected with pastures and orchards.

In connection with one of the orchard experiments, a soil analysis was made of the various plots, and the figures obtained are of considerable interest.

The fertilizers were applied in the early spring of 1945, and the soil analysis made in the autumn of 1946. Soil samples were taken from numerous points on each area and the results were in close agreement, the figures giving the averages of all determinations. The limestone used was of the dolomitic type.

TABLE 78. EFFECT ON SOME SOIL CONSTITUENTS OF OPEN-HEARTH STEAM-GRANULATED TAPPING SLAG

Treatment	pH	Available		Exchangeable	
		P_2O_5	K_2O	CaO	MgO
	value	p.p.m.	p.p.m.	p.p.m.	p.p.m.
Slag, 3 tons per acre, applied 1945	5.93	423	166	2,323	396
No treatment	4.34	116	130	317	142
Ground limestone, 3 tons per acre, plus 20% superphosphate, 1,000 lb. per acre; applied 1945	5.69	188	130	1,253	459

It will be noted that the pH value of the soil was raised more by three tons of slag than by three tons of dolomitic limestone plus 1000 pounds of superphosphate.

Treatment with superphosphate and limestone raised the level of available phosphoric acid appreciably, yet not nearly to the extent that the slag did.

The exchangeable CaO content of the slag-treated soil was double that of the dolomitic limestone—and superphosphate-treated soil, which in its turn was four times that of the untreated soil.

The exchangeable MgO content of the slag-treated soil was nearly three times that of the untreated soil, but was not quite so high as that of the dolomitic limestone-and superphosphate-treated soil.

GENERAL CONCLUSIONS

The open-hearth steam-granulated tapping slag promises to be of high value to the farmer from the standpoint of reducing soil acidity, supplying available phosphoric acid, magnesium, and perhaps supplying minor elements.

An Analysis of Some Soil Fertility Experiments

(A. Kelsall)

Plant nutritional studies of Nova Scotia soils emphasize the importance of limestone and phosphatic fertilizers. Other plant nutritional elements appear important, but under most conditions on upland soils, the value of nitrogen and potash appears to be subsidiary to that of the establishment of an optimum pH value (amount of acidity) and a suitable reserve of phosphorus.

This summary analysis is written, therefore, with a view to clarifying some of the evidence bearing on this matter. Some of the experiments described here are to be found in more detail in other parts of this report, though the figures may not be quite identical as the number of years under review may differ.

FERTILIZERS AND GROUND LIMESTONE

This experiment was laid down in 1914 and was in active operation for thirty years. The area was in replicated plots and in a three-year rotation of hoed crop, wheat, and clover hay. The experiment consists of two series of similar plots treated with different fertilizer mixtures, one series in addition receiving limestone.

The figures presented in Table 79 are the averages of all the crops grown during thirty years. For the purpose of this report, all plots not receiving limestone are averaged and compared with all plots receiving limestone. In order to make the effect of limestone easily apparent to the eye, and in terms of percentage, the yield of the crops not receiving lime is represented by the figure 100.

Limestone at the rate of two tons per acre was applied in 1914, 1917, 1920 and 1923. Thus, the total limestone that was applied is eight tons per acre. In 1945, 22 years after the previous application of limestone, the effect was nearly as marked as ever.

TABLE 79. FERTILIZERS AND GROUND LIMESTONE: EFFECT OF GROUND LIMESTONE ON YIELDS OF FIVE CROPS DURING THIRTY YEARS

Treatment	Comparative Yields				
	Wheat	Clover	Mangels	Swedes	Potatoes
Without lime	100	100	100	100	100
With lime	157.1	174.7	204.4	117.5	113.6

Table 79 clearly shows the increased yield due to limestone applications over a period of thirty years, the increases being very large with respect to mangels, clover and wheat, and comparatively small in the case of swedes and potatoes.

FERTILIZED PASTURE PLOTS

This experiment was commenced in 1941, and the relative yields given in Table 80 are the averages for five years. The letter O represents no treatment; N represents nitrate of soda at the rate of 100 lb. annually, and N_3, at the rate of 300 lb. annually; P represents superphosphate at the rate of 200 lb. annually, and P_3, at the rate of 600 lb. annually; K represents muriate of potash at the rate of 33 lb. annually, and K_3, at the rate of 100 lb. annually.

As in Table 79, the yields on the untreated areas are represented by the arbitrary figure of 100.

TABLE 80. FERTILIZED PASTURE PLOTS: EFFECT OF FERTILIZERS ON YIELDS FOR FIVE YEARS

Treatment	Yield
O	100
N	197
N_3	335
P	349
K	98
PK	456
NPK	512
NP_3K_3	877
N_3PK	594

The outstanding results shown in Table 80 are:

Nitrogen alone, at the low rate, practically doubled the yield; at the high rate slightly more than tripled it.

Phosphorus alone at the low rate increased the yield from 100 to 349. It is interesting to note that 200 pounds of superphosphate produced slightly more herbage than 300 pounds of nitrate of soda.

While potash alone produced no increased yields, when combined with phosphorus it increased yield very materially, from 349 to 456.

The addition of nitrate of soda to the phosphorus and potash increased the yields over that of phosphorus and potash alone, from 456 to 512.

Comparing the complete fertilizer at the low rates with the complete fertilizer in which the nitrogen is tripled, the yield was increased from 512 to 594. In other words, tripling the dosage of nitrogen in a complete fertilizer increased the yield somewhat, but it did not increase the yield greatly. However, where the nitrogen remained at the low level but where the minerals were tripled in dosage, there was an increased yield from 512 to 877.

As measured in terms of total herbage produced, one of the outstanding results in the production of herbage on pasture is the high importance of minerals, and of phosphorus in particular.

FERTILIZER FOR POTATOES (*Halls Harbor*)

Under the Illustration Stations' Division an experiment was commenced in 1940 on the fertilization of potatoes. There were 18 plots, triplicated, in this project, which included nitrogen at two levels, phosphorus at three levels, and potash at three levels. The 18 plots comprise combinations of these different quantities of nutrients.

For the purpose of this report general averages are given, embracing averages of all plots concerned for each year in which the experiment was conducted.

The fertilizer application was at the rate of one ton per acre, and for comparative purposes the arbitrary figure 100 is used as representing the yield from the lowest dosage of the element under consideration.

TABLE 81. FERTILIZER FOR POTATOES: AVERAGE YIELDS, ALL PLOTS

Average of all plots receiving 2½ per cent nitrogen	100
" " " " 5 " " "	99
Average of all plots receiving 5 per cent phosphoric acid	100
" " " " 10 " " " "	116
" " " " 20 " " " "	127
Average of all plots receiving no potash	110
" " " " 5 per cent potash	117
" " " " 10 " " "	113

From these averages in Table 81 the following conclusions may be drawn:

(1) On this particular soil, one ton of fertilizer containing 2½ per cent nitrogen gave as high yields as one containing 5 per cent nitrogen. Increasing the dosage of phosphoric acid above 5 per cent increased the yield considerably both with the 10 per cent and the 20 per cent.

(2) The use of one ton of fertilizer containing 5 per cent potash increased the yield from 100 to 117. However, increase of the potash to 10 per cent did not increase the yield over the 5 per cent yield. In fact, there was a slight decrease, but this is accounted for by those plots which contained high potash and low phosphorus, in which the decrease was considerable.

The figures given in Table 81 are inadequate to express the full scope and implications of this experiment, but they are about the best which may be devised for bringing out the pertinent points. No plots were included in the experiment which were without nitrogen or without phosphorus, as it was known beforehand that each of these was necessary to produce a reasonable crop. Plots without potash produced reasonably good yields, although the addition of potash in small dosage materially increased the yield and was profitable.

The outstanding result from this experiment is that highest yields were obtained from formulas having comparatively low percentages of both nitrogen and potash, and comparatively high in phosphorus.

PLANT FOOD DEFICIENCY TESTS

Under the Illustration Stations' Division, an extensive series of tests was commenced in 1939. The plots were in duplicate and the results reported herewith are the averages from six Illustration Stations scattered throughout the province. The crops grown were in a four-year rotation of swedes, oats, clover hay and timothy hay, the fertilizers being applied only to the first crop in the rotation, swedes. The fields concerned were representative of average farm fields, and it is to be noted that the results obtained were very similar in each of the six locations, differing mainly in degree.

For comparative purposes, the yields shown in Table 82 are expressed in terms of the yield of the check plots, which are assigned the arbitrary figure 100.

TABLE 82. PLANT FOOD DEFICIENCY TESTS: YIELDS THROUGH A FOUR-YEAR ROTATION CONDUCTED ON SIX ILLUSTRATION STATIONS

Treatment	Swedes 1939	Oats, 1940	Clover, 1941	Timothy, 1942	Swedes, oats, clover, timothy	Swedes, oats, timothy
Check	100	100	100	100	100	100
500 lb. superphosphate	132	143	186	137	149.5	137.3
100 lb. muriate of potash	104	104	111	115	108.5	107.7
500 lb. superphosphate, 100 lb. muriate of potash	127	153	171	139	147.5	139.7
250 lb. sulphate of ammonia	97	123	107	104	107.8	108.0
250 lb. sulphate of ammonia, 500 lb. superphosphate	136	152	156	144	147.0	144.0
250 lb. sulphate of ammonia, 100 lb. muriate of potash	107	111	122	125	116.2	114.3
250 lb. sulphate of ammonia, 500 lb. superphosphate, 100 lb. muriate of potash	145	153	166	154	154.5	150.6

In the last two columns of Table 82, figures are shown representing the average yields of all crops at all these six points. The last column shows the average yield of swedes, oats and timothy, omitting the clover. This is done, because at one Station out of the six, there was an excessively high yield of clover hay on one of the plots. This raises the figure of clover hay, resulting from superphosphate treatment alone, to a high level. It might be that this is a true result, but it is open to the suspicion of resulting from some unknown experimental error. From an examination of Table 82 the following facts are evident:

(1) Nitrogen alone increased the yield of all crops from 100 to approximately 108.

(2) Potash alone increased the yield of all crops from 100 to approximately 108.

(3) Phosphorus alone increased the yield of all crops from 100 to approximately 137.

(4) Nitrogen and potash increased the yield of all crops from 100 to approximately 115, nitrogen and phosphorus from 100 to approximately 145, and complete fertilizer from 100 to approximately 152.

The principal point to be noted from this extensive experiment is the comparatively low increase in yield from either nitrogen or potash when used separately or when used together. On the other hand, phosphorus used alone produced substantially increased yields, and mixtures in which phosphorus was present did likewise. The complete fertilizer produced the highest yields, but of the three ingredients phosphorus is obviously of greatest importance.

NUTRIENT RESPONSES OF NOVA SCOTIA SOILS, POT EXPERIMENTS

These experiments were conducted in replicated pots in the greenhouse, being part of a larger project. The figures given in Table 83 are the average of results obtained from eight distinct soil types, and it is to be noted that each of these soil types responded to added nutrients in a similar manner, the differences being of degree rather than of kind. There was one exception to this. With barley, the plant crop used under these tests, there was a response to limestone on four of the soils and no response on the other four.

The arbitrary figure 100 is used to designate the yield, on the check pots, of those soils which responded to limestone.

The soils used in this experiment were all from old pastures or run-out hay fields which either had never been previously treated or had not been treated for many years.

Table 83 shows the treatments used and the responses obtained.

TABLE 83. NUTRIENT RESPONSES OF NOVA SCOTIA SOILS, POT EXPERIMENTS

Treatment per acre	Soils which did respond to limestone	Soils which did not respond to limestone
Check	100	185
5–0–5, 1,000 lb.	188	328
5–0–5, 1,000 lb. plus superphosphate 500 lb.	577	694
5–0–5, 1,000 lb., plus superphosphate, 500 lb. and limestone, 2,500 lb.	694	702

Soils which responded to limestone were naturally less fertile than those which did not respond.

While the application of nitrogen and potash gave considerable increase in yield, nevertheless this was relatively small as compared with the additional increases from phosphorus.

The addition of phosphorus to nitrogen and potash increased the yield very greatly.

Limestone increased the yield considerably on some soils but not on others.

This experiment demonstrates clearly the importance of phosphorus as a plant nutrient, on a wide series of soil types.

CONCLUSIONS

In the descriptions of the various projects an endeavour has been made to portray the general characteristics of the response to fertilizers of some of the upland soils of Nova Scotia. While over-simplification is perhaps not desirable, yet the pattern as seen in the present state of knowledge is a plain one. The application of limestone to most Nova Scotia soils is a basic necessity and an adequate supply of phosphorus is of prime importance. It is not until these requirements are satisfied that benefit usually results from added nitrogen and potash.

Illustration Stations

(F. B. Kinsman)

Introduction

The five Illustration Stations in western Nova Scotia have been actively engaged in carrying on field tests. These fact-finding studies covered the main crop, livestock and soil problems common to agriculture in the region. Much work has been done in re-arranging the farm fields on all the stations, and different rotations have been established, using all the tillage land. On each station, barnyard manure is applied to the hoed crop each year, the entire farm being treated uniformly within the limits of the rotation practised.

In many cases, fertilized pasture fields have been placed near the farm buildings to economize on fencing. A great deal of work has been conducted with ground limestone, slags and fertilizers of various formulas on different rotations. A well planned rotation, combined with good cultural methods and economical use of commercial fertilizer to supplement manure and ground limestone, has materially increased the soil fertility on these lands. The effect has been to produce more and better roots, grain and clover for livestock feed and consequently more profit to the operator. The following are the Illustration Stations' operators, and the location where the work is being conducted by them:

Joseph R. Deveau, Mavillette, Digby County;
W. I. Falkenham, Lilydale, Lunenburg County;
D. E. Knight, Chegoggin, Yarmouth County;
J. L. Main, Noel Shore, Hants County;
Ralph H. Zwicker, Newport, Hants County.

A sixth Illustration Station, operated by Gordon Steele at Halls Harbor, N.S., specializes in potato work.

Cranberry Illustration Station. The work at Port Mouton, N.S., (previously reported) having been completed, the contract was terminated and a section of new bog was leased at Aylesford in 1941, for the much-needed testing of new varieties and selections of cranberries.

The new location is well laid out and modern in every way. The work is described in more detail in the section on cranberries, elsewhere in this report.

Plant Food Deficiency Studies

Soils of different types as they occur on the Illustration Stations located at Springfield, Sydney River, Meteghan Centre, Chegoggin, North East Margaree, and Knoydart were selected in the fall of 1938 to ascertain the long-period trends of crop response resulting from applications of farmyard manure, also single elements of plant food when applied alone, when combined, when supplemented with farmyard manure, and when associated with lime and borax.

The land was ploughed six inches deep in the fall. The following spring a well prepared seed-bed was established. The areas chosen were divided into one-fortieth acre plots, duplicating in two series of eight plots each the comparative results from applications of nitrogen, phosphorus and potash, used singly and combined in the proportion contained in a 5-10-5 formula. A five-foot pathway was left between all plots. A roadway twelve feet wide was used to separate the chemical fertilizers from the manured area. This latter area received farmyard manure alone, manure

supplemented with single elements of plant food, including boron; manure with lime at the rate of 1 and 3 tons per acre; and manure with a fertilizer of 2-12-6 formula at three rates: 400, 800 and 1600 pounds per acre.

In the spring of 1939 on the range receiving manure, a general application of ten tons per acre was broadcast. After the plots had been measured, the land was harrowed twice, and the chemical fertilizers applied. The seed-bed was completed by harrowing the fertilizer into the soil.

The Wilhelmsburger variety of turnips was sown at all stations. Duplicate weighings were made at harvest time. In the spring of 1940 these areas were sown with oats at the rate of three bushels per acre and seeded with grass seed made up of a mixture of eight pounds of timothy, five pounds of common red clover, three of alsike, and three of alfalfa, per acre. Yields from all plots were obtained at harvest time in the fall of 1940. The same procedure has been followed with the clover and timothy crops. No additional manure or fertilizer was added during the rotation.

The yields of turnips, oats, clover and timothy are given in Table 84.

TABLE 84. AVERAGE YIELDS PER ACRE IN PLANT FOOD DEFICIENCY TEST

	Plot Treatments	Swedes, 1939	Oats, 1940	Clover, 1941	Timothy, 1942
		tons	bu.	lb.	lb.
(1)	Check, no treatment	15.4	30.1	1,949.6	2,261
(2)	500 lb. superphosphate	20.3	44.5	3,630.5	3,096
(3)	100 lb. muriate potash	15.9	32.4	2,172.0	2,589
(4)	500 lb. superphosphate, 100 lb. muriate potash	19.6	47.6	3,325.0	3,147
(5)	250 lb. sulphate ammonia	14.9	38.2	2,085.3	2,345
(6)	250 lb. sulphate ammonia, 500 lb. superphosphate	20.9	47.2	3,041.1	3,241
(7)	250 lb. sulphate ammonia, 100 lb. muriate potash	16.6	35.7	2,381.0	2,831
(8)	250 lb. sulphate ammonia, 500 lb. superphosphate, 100 lb. muriate potash	22.6	47.7	3,240.0	3,483
(9)	10 tons manure	19.3	47.9	3,410.8	3,342
(10)	10 tons manure, 480 lb. superphosphate	23.7	55.9	4,538.0	3,949
(11)	10 tons manure, 1 ton lime	20.0	49.0	4,413.9	4,145
(12)	10 tons manure, 3 tons lime	20.1	47.3	5,629.0	4,857
(13)	10 tons manure, 400 lb. 2–12–6	21.5	50.0	4,414.1	4,004
(14)	10 tons manure, 800 lb. 2–12–6	23.1	57.6	4,513.8	4,104
(15)	10 tons manure, 800 lb. 2–12–6, 20 lb. borax	23.1	58.9	4,728.9	4,163
(16)	10 tons manure, 1,600 lb. 2–12–6	23.4	63.7	5,094.1	4,261

The following conclusions may be drawn from four years' results with turnips, oats, clover and timothy hay, basing the conclusions on the average yield at all stations:

Plot 1.—The yield shows the soil to be in a moderate state of fertility.

Plot 2.—Results from 500 pounds of superphosphate per acre show phosphorus is deficient in the soils treated, and the increased yields from this application are pronounced at all stations. The fouryear crop records show definitely higher yields from all treated plots over the untreated, very nearly equal to those from plot 8, where a complete fertilizer was used.

Plot 3.—Potash when used alone showed no appreciable increase over no treatment.

Plot 4.—Although yields of grain and timothy hay were slightly increased over plot 2, the turnips and clover hay yields were not so great.

Plot 5.—The yield of turnips was slightly lower than from no treatment. There was a slightly increased yield of grain but no material increase in the clover or timothy hay crops over the untreated plot.

Plot 6.—As compared with plot 2, grain yields were increased three bushels. Turnips showed little improvement. The clover-hay yield was lower, whereas timothy hay showed a slight increase over plot 2 (receiving superphosphate alone).

Plot 7.—Sulphate of ammonia and potash used jointly showed only slightly increased yields in the turnip crop over the check, and 5.6 bushels of oats, 431.4 pounds of clover, and 570 pounds of timothy hay more than the no-treatment plot.

Plot 8.—Complete fertilizer showed a gain over chemicals used singly or the combination of sulphate of ammonia and potash. The difference was not, however, materially greater than from superphosphate alone.

Plot 9.—Ten tons of manure increased the turnip yields 3.9 tons; the oats, 17.8 bushels; the clover, 1461.2 pounds; and the timothy, 1081 pounds, over the untreated plot.

Plot 10.—The application of 480 pounds of superphosphate with ten tons of manure gave increased yields over plot 9, receiving manure alone, of 4.40 tons of turnips, 8 bushels of oats, 1127.5 pounds of clover and 607 pounds of timothy hay.

Plot 11.—One ton of lime used in conjunction with ten tons of manure did not bring about a noticeable increased yield of turnips and only 1.1 more bushels of oats. There was, however, a substantial increase in the clover and timothy hay plots of 1003 and 803 pounds, respectively.

Plot 12.—A three-ton application of lime per acre did not materially increase the turnip or grain crop over manure alone, yet gave a decided increase in clover and timothy. The clover crop showed an increase of 2218 pounds, and the timothy, 1515 pounds, more than the manure plot.

Plots 13, 14, 15 and 16.—Using a 2-12-6 formula, these plots received respectively, 400 pounds, 800 pounds, 800 pounds and 20 pounds of borax, and 1600 pounds of 2-12-6 in addition to 10 tons of manure. They showed a slightly higher yield of turnips with a more luxuriant growth of foliage, due to the increased application of fertilizer. There was a yield of fifty bushels of oats where 400 pounds of 2-12-6 was applied, 58.9 bushels where 800 pounds was used, and 63.7 bushels where 1600 pounds of 2-12-6 was applied. Clover hay was increased from 4414 pounds to 5094 pounds, due to the increase of commercial fertilizers from 400 to 1600 pounds per acre. The yields of timothy hay, however, increased only slightly, the yields being 4004, 4104, 4163 and 4261 pounds, respectively. There apparently was no beneficial effect from the borax, except possibly in the clover hay of 1941, where it showed a slight increase over the same amount of 2-12-6 used alone.

Fertilized Pastures

Much work has been done with fertilized pastures on the Illustration Stations in Nova Scotia. In 1924, a fact-finding test was undertaken, and since then a fertilized rotation has been followed, allowing the cows to feed on one fertilized area, and then moving them to another. Milk weights are kept and also records of the quality and amount of the herbage.

In 1941, a standard pasture experiment was begun at all stations in Nova Scotia, for the purpose of studying fertilizer formulae. This experiment consists of seven plots, two of which are untreated and five are fertilized. Part of the area covered by the plots receives ground limestone as a surface application on sod, applied crosswise on each fertilized area. The rest of the area receives fertilizer

alone. Pasture cages are placed on all plots. Grass clippings are taken from under the cages and weighed every three weeks during the grazing season. The treatment per acre is as follows:

Plot 6A—Check, no treatment.

Plot 1 —100 lb. ammonium sulphate annually.
600 lb. superphosphate, 20 per cent } every 3 years.
120 lb. muriate of potash }

Plot 2 —600 lb. superphosphate, 20 per cent } every 3 years.
120 lb. muriate of potash }

Plot 3 —600 lb. superphosphate, 20 per cent, every 3 years.

Plot 4 —100 lb. ammonium sulphate }
200 lb. superphosphate, 20 per cent } annually.
40 lb. muriate of potash }

Plot 5 —100 lb. ammonium sulphate }
600 lb. superphosphate, 20 per cent } annually.
120 lb. muriate of potash }

Plot 6 —Check, no treatment.

The yields from the fertilized pasture areas have been good. The dairy herd can get from ten to twelve days of earlier grazing on the fertilized areas, due to the increased growth of herbage.

Dealing with the pasture results and with the area receiving no ground limestone first, it will be found from Table 85 that all treated plots showed an increase over the untreated. Plot 3, the lowest of the fertilized plots, produced 6.4 tons more herbage than the no-treatment plot, and plot 5, the highest-yielding, 9.8 tons more.

The percentage of clovers on the various unlimed plots were, in order: plot 2, 67.4; 5, 66.8; 3, 66.0; 4, 63.4; 1, 61.4. There was a greater percentage of grasses of poorer quality on the unlimed area. Very noticeable was the higher percentage of weed growth. There was a striking difference in the way the cattle grazed on the areas treated with lime and on those unlimed, particularly at Mavillette, Chegoggin and Lilydale. Little or no clipping of old grasses that had not been eaten was necessary on the limed areas but in all cases where no lime was applied cutting of grasses had to be done.

Comparing plots 1 and 2, and considering the yields from both the limed and unlimed areas, it appears that the nitrogen applied was beneficial, giving more herbage. Also, in plots 2 and 3, potash was of some benefit, and in plots 3 and 4, a large amount of phosphoric acid alone gave better pasture growth than a smaller amount supplemented with nitrogen and potash. Also the phosphoric acid in plot 5, which is applied annually, has produced a continued increase in tonnage without suppressing the clover growth.

At five stations, the limed and fertilized areas produced an average total tonnage of 79.6 tons, as compared with 66.6 tons where lime was not applied, the fertilizer treatments being otherwise relatively the same. Plot 5, which received fertilizer annually, produced the highest yield, 21.4 tons, which was 14.5 tons more than from the untreated, and six tons more than from plot 1, which receives the same fertilizer treatment but only every third year. The increase in the clover on the limed over the unlimed areas was: plot 1, 11.6 per cent; 2, 10.4 per cent; 3, 8.6 per cent; 4, 5.6 per cent; 5, 6.0 per cent.

TABLE 85. YIELDS AND PER CENT CLOVERS, GRASSES, AND WEEDS IN FERTILIZED PASTURE TRIALS. UNLIMED AREA

STATION	Plot 1: 100 lb. Amm. Sulph. annually, 600 lb. Super. 20%, 120 lb. Mur. of Pot. every three years				Plot 2: 600 lb. Super. 20%, 120 lb. Mur. of Pot. every three years				Plot 3: 600 lb. Super. 20% every three years				Plot 4: 100 lb. Amm. Sulph., 200 lb. Super. 20%, 40 lb. Mur. of Pot. annually				Plot 5: 100 lb. Amm. Sulph., 600 lb. Super. 20%, 120 lb. Mur. of Pot. annually				Average of Checks			
	Yield per acre	Clovers	Grasses	Weeds	Yield per acre	Clovers	Grasses	Weeds	Yield per acre	Clovers	Grasses	Weeds	Yield per acre	Clovers	Grasses	Weeds	Yield per acre	Clovers	Grasses	Weeds	Yield per acre	Clovers	Grasses	Weeds
	ton	%	%	%	ton	%	%	%	ton	%	%	%	ton	%	%	%	ton	%	%	%	ton	%	%	%
Noel Shore	10.9	57	37	6	11.2	70	26	4	10.0	71	25	4	10.3	64	28	8	12.5	70	25	5	6.9	50	41	9
Newport	13.9	70	27	3	18.4	72	24	4	16.9	60	34	5	11.7	60	35	5	22.5	72	24	4	8.7	55	35	10
Lilydale	10.4	50	44	6	12.3	55	38	7	10.5	60	32	8	12.3	60	37	3	14.9	54	40	6	3.2	20	66	14
Mavillette	13.6	60	30	10	14.9	66	24	10	14.2	70	21	9	14.1	68	25	7	15.8	70	22	8	5.3	20	61	19
Chegoggin	11.7	70	22	8	11.5	74	21	5	11.7	70	25	5	11.5	65	29	6	15.0	68	28	4	7.5	33	50	17
Average	12.1	61.4	32.0	6.6	13.7	67.4	26.6	6.0	12.7	66.0	27.4	6.6	12.0	63.4	30.8	5.8	16.1	66.8	27.8	5.4	6.3	35.6	50.6	13.8

TABLE 86. YIELDS AND PER CENT CLOVERS, GRASSES, AND WEEDS IN FERTILIZED PASTURE TRIALS. LIMED AREA

STATION	Plot 1: 100 lb. Amm. Sulph. annually, 600 lb. Super. 20%, 120 lb. Mur. of Pot. every three years				Plot 2: 600 lb. Super. 20%, 120 lb. Mur. of Pot. every three years				Plot 3: 600 lb. Super. 20% every three years				Plot 4: 100 lb. Amm. Sulph., 200 lb. Super. 20%, 40 lb. Mur. of Pot. annually				Plot 5: 100 lb. Amm. Sulph., 600 lb. Super. 20%, 120 lb. Mur. of Pot. annually				Average of Checks			
	Yield per acre	Clovers	Grasses	Weeds	Yield per acre	Clovers	Grasses	Weeds	Yield per acre	Clovers	Grasses	Weeds	Yield per acre	Clovers	Grasses	Weeds	Yield per acre	Clovers	Grasses	Weeds	Yield per acre	Clovers	Grasses	Weeds
	ton	%	%	%	ton	%	%	%	ton	%	%	%	ton	%	%	%	ton	%	%	%	ton	%	%	%
Noel Shore	11.4	68	27	5	11.4	75	22	3	13.2	72	24	4	16.3	66	31	3	18.8	70	27	3	8.1	60	34	6
Newport	21.0	72	26	2	17.0	75	23	2	18.0	76	23	1	17.5	68	26	4	23.8	70	30	0	8.5	48	42	10
Lilydale	13.7	61	38	1	13.4	70	27	3	10.2	64	31	5	13.8	60	33	7	20.5	61	33	6	5.7	31	60	9
Mavillette	17.5	88	11	1	13.0	89	9	2	20.0	84	12	4	11.3	80	17	3	25.1	85	13	1	3.9	35	50	15
Chegoggin	13.7	76	19	5	11.9	80	16	4	13.4	77	18	5	13.5	71	23	6	18.7	78	20	2	8.3	60	20	20
Average	15.4	73.0	24.2	2.8	13.3	77.8	19.4	2.8	15.0	74.6	21.6	3.8	14.5	69.0	26.0	4.6	21.4	72.8	24.6	2.4	6.9	46.8	41.2	12.0

The percentage of clovers on the limed and fertilized plots was: plot 2, 77.8; 3, 74.6; 1, 73.0; 5, 72.8; 4, 69.0 per cent, while the no-treatment plot contained 46.8 per cent. Plots 2 and 3, receiving no nitrogen, showed a slightly higher percentage of clovers. All fertilized plots showed a low percentage of weed growth, ranging from 2.4 to 4.6 per cent, while on the untreated plots there was 12 per cent. See Tables 85 and 86.

Study of Farm Business

The study and practice of farm business is a "must" if financial success in farming is to be achieved. A record book is supplied to each operator in which is entered each item of farm revenue and expenditure on the station. Costs incurred on cattle, dairy products, field crops, hogs, poultry, sheep, horses, machinery, buildings, taxes, labour and farm produce consumed in the household are all charged against the farm, and the revenue from each item is listed.

Two copies of such records are sent to the Supervisor weekly. Each week's expenditure and revenue are tabulated for the year on the financial sheet, which thus shows a profit or loss for the year. The operators of the Illustration Stations are good representatives of the farmers within their districts, with respect to their ability, and holdings, buildings and the type of farming in which they are engaged. A profit has been shown on the farming operations of each operator, some, of course, being higher than others.

The chief source of revenue at these stations is from dairy products. The sale of beef is negligible, most of the dairy stock being sold for breeding purposes. Few of the operators obtain any appreciable income from truck crops. Because dairying is the main source of income, crops on the stations are planned to furnish good pastures during the summer, feed for livestock in winter, and plenty of succulent feed to maintain the milk supply during the drier periods of July and August, when the fertilized pastures are short. Careful planning aims to make these stations as nearly self-sustaining as possible. Encouragement has been given the operators to produce as much of their home-grown feed as possible. A census is made yearly of the livestock to be kept for the next year, and the acreage assigned to special food crops, such as turnips, is adjusted in proportion to the number of livestock to be kept.

All feeds that are produced are used on the stations, except an occasional surplus which is sold to the farmers in the district. Foundation and certified seed potatoes are also sold, two of the operators having developed this into a very successful enterprise.

A five-year rotation is being conducted on all the stations except Mavillette. This allows two-fifths of the tillage area to be sown with grain each year, one-fifth in hoed crop, one-fifth in clover and one-fifth in timothy. This large proportion of hoed crop, the practice of proper cultural methods, the use of clover and early-cut hay, and the heavier yields of grain obtained by sowing new varieties on a larger acreage, are practices which could well be copied by the farmers of the district, and which have returned more profit to the operators than is usually obtained from the average farm.

Superphosphate has been used with manure to make a balanced fertilizer for the production of turnips. Succeeding crops such as grain, clover and timothy hay depend entirely on the residual effects from the manure and fertilizer. Suitable pasture lands are fertilized to promote early grazing and more herbage per acre. Alfalfa and clover crops each year have given striking response to ground limestone.

During the 1947 season, the capital value of the land and buildings, livestock, feeds and supplies, machinery and equipment per station was as follows: Chegoggin, $15,240.99; Mavillette, $9,867.36; Lilydale, $24,608.17: Noel Shore, $14,457.17;

Newport, $23,449.47. The total expenses per station were as follows: Chegoggin, $5,120.78; Mavillette, $3,982.94; Lilydale, $9,645.34; Noel Shore, $5,989.83; Newport, $9,574.63.

A summary statement of Farm Revenue and Expenditure for the year 1947 appears as follows:

Total revenue, 5 stations	$30,712.20
Total cost, 5 stations	16,914.00
Average revenue per station	6,142.44
Average cash expenditure per station	3,382.80
Average net revenue per station	4,271.97
Total cash expense as per cent of total revenue	55.07%

All but one station showed a material increase in profit during this time. The Lilydale station, unable to compete for farm labour with the high wages prevailing in a nearby industrial and fishing center, found it impossible to produce as much home-grown feeds as usual. The increase in profit which was obtained in 1947 over that obtained in 1939 was as follows: Chegoggin, $644.92; Newport, $3,532.69; Mavillette, $1,481.58; Lilydale, $162.97; Springfield, $301.94; Noel Shore, $1,059.48.

Table 87 shows the contribution of the different farm enterprises to the total cash income for 1947.

TABLE 87. ILLUSTRATION STATIONS IN NOVA SCOTIA: PERCENTAGE CONTRIBUTION OF THE DIFFERENT FARM ENTERPRISES TO TOTAL CASH INCOME, 1947

	%
Cattle and dairy products	64.00
Field crops	12.12
Poultry	8.48
Hogs	4.92
Machinery and buildings	4.18
Farm produce to household	3.34
Miscellaneous	1.55
Sheep	0.94
Garden and orchard	0.27
Horses	0.20
Total	100.00

Fertilizer for Potatoes

(A. Kelsall)

This was an attempt to determine the best fertilizer treatment for potatoes. The work was conducted at Halls Harbour, Kings county, on a field in the midst of the potato-growing area.

Through the courtesy of the Division of Chemistry, Science Service, analysis was made of samples of soil taken at four points in the field at the initiation of the project in 1940, and this is shown in Table 88.

TABLE 88. ANALYSIS OF SOILS FROM POTATO FIELD AT HALLS HARBOUR, N.S.

Identification (corner of field)	N.E.	N.W.	S.E.	S.W.
Moisture (%)	5.92	6.03	5.42	5.87
Loss on ignition (%)	14.38	12.20	13.18	12.45
Nitrogen (%)	0.448	0.333	0.406	0.358
Exchangeable (or available):				
Lime (CaO) (%)	0.171	0.129	0.151	0.175
Magnesia (MgO) (%)	0.012	0.011	0.014	0.016
Potash (K_2O) (%)	0.007	0.006	0.025	0.011
Phosphoric acid (P_2O_5) (%)	0.258	0.183	0.274	0.224
Total available P_2O_5 (p.p.m.)	65	20	65	45
Water soluble boron p.p.m.	0.30	0.20	0.31	0.30
pH value (measure of acidity.)	5.50	5.59	5.30	5.70

The most noticeable feature is the high content of organic matter and of total nitrogen. The exchangeable potash is low in three samples and high in one. The available phosphoric acid is low in two samples and very low in the other two. The pH value is about the figure that is considered desirable for potatoes.

PROCEDURE

The field was taken from an old comparatively run-out sod on which followed the first potato crop. The next two years were potatoes following potatoes, on the same plots and with the same treatment. In the succeeding years, the potatoes were in a three-year rotation following oats and hay. The project was continued through each of the years 1940 to 1946, inclusive, with the exception of 1943 and 1944. The potato variety Katahdin was used throughout. The fertilizer treatment was at the rate of one ton per acre of the formula designated. This, of course, does not mean one ton of actual material. On many plots, the material weighed much less than one ton, and on some plots considerably more than one ton.

Fig. 25—Potato Fertilizer Experiment at Halls Harbor Illustration Station.

The fertilizer in all cases was applied in the row and mixed with the soil, and was applied only to the potato crop.

The chemicals used in producing the desired formulae were nitrate of soda, superphosphate and muriate of potash, with the exception of the last two years, when ammonium nitrate was used in place of nitrate of soda.

The cost figures are based on $1.75 per unit of nitrogen, $1.10 per unit of phosphoric acid, and 80 cents per unit of potash. These figures may be a trifle lower than retail prices generally prevailing. No charges were included for mixing the chemicals.

In 1940, there were nine replicates of all plots; in 1941, six replicates, and in the other three years, three replicates. The figures given are the average yield in bushels per acre of the replicate plots for the year concerned. In view of the close harmony of the yields from the numerous replicates throughout the entire period the results are considered highly significant.

Table 89 shows the treatment of the plots. Nitrogen was used at two levels: 2½ and 5 per cent. Phosphoric acid was used at three levels: 5, 10 and 20 per cent. Potash was used at three levels: zero, 5 and 10 per cent. The treatments consisted of variations of these ingredients at the different levels.

TABLE 89. FERTILIZER FOR POTATOES: FORMULA OF TREATMENTS (BASED ON ONE TON PER ACRE)

Plot number	Treatment	Plot number	Treatment
1	2½–5–0	10	5–5–0
2	2½–10–0	11	5–10–0
3	2½–20–0	12	5–20–0
4	2½–5–5	13	5–5–5
5	2½–10–5	14	5–10–5
6	2½–20–5	15	5–20–5
7	2½–5–10	16	5–5–10
8	2½–10–10	17	5–10–10
9	2½–10–10	18	5–20–10

TABLE 90. FERTILIZER FOR POTATOES: YIELDS AND COSTS (PLOTS ARRANGED IN ORDER OF YIELD)

Treatment	Cost per ton of fertilizer	Plot number	Average yield per acre					
			1940	1941	1942	1945	1946	Average
	$		bu.	bu.	bu.	bu.	bu.	bu.
5–20–5	34.75	15	372	413	423	296	331	367
2½–20–5	30.38	6	377	383	437	281	324	361
5–20–10	38.75	18	382	412	375	292	317	356
2½–20–10	34.28	9	358	368	436	263	330	351
2½–10–10	23.38	8	371	379	373	280	296	340
5–10–10	27.75	17	376	386	293	287	328	334
5–10–5	23.75	14	351	352	402	277	273	331
2½–20–0	26.38	3	334	335	359	218	301	310
2½–10–5	19.38	5	312	337	361	232	298	308
5–10–0	19.75	11	330	284	327	240	345	306
5–20–0	30.75	12	326	325	343	243	291	305
5–5–5	18.25	13	340	329	315	238	267	298
2½–5–5	13.88	4	332	298	318	230	311	298
2½–5–10	17.88	7	335	305	276	201	265	276
5–5–10	22.25	16	310	282	240	263	275	274
2½–10–0	15.38	2	325	308	309	224	199	273
2½–5–0	9.88	1	278	265	309	154	240	250
5–5–0	14.25	10	286	268	245	164	278	248

TABLE 91. FERTILIZER FOR POTATOES: ORDER OF YIELD IN EACH YEAR

Formula	1940	1941	1942	1945	1946	Average yield per acre
						bu.
N–5–0	9	9	8	9	9	249
N–10–0	7	7	7	6	7	290
N–20–0	5	6	5	8	4	308
N–5–5	6	4	6	5	5	298
N–10–5	4	5	3	4	6	320
N–20–5	1	1	1	1	1	364
N–5–10	8	8	9	7	8	275
N–10–10	2	3	4	2	3	337
N–20–10	3	2	2	3	2	354

Table 90 shows the cost of the materials per ton per acre, the average yields obtained on each treatment during each of the five years, and the general average covering the whole period. These are arranged in order of average yield.

A study of Tables 90 and 91 shows that in general there was fair agreement in the relative standing of the various plots during each of the years. While there are some variations, in the main the treatments which gave high, low or intermediate yields in any one year gave similar yields every year.

In this summary report it is impossible to analyse the records in detail. The average yield of all plots in all years receiving 2½ per cent nitrogen was 307 bushels, and of those receiving 5 per cent nitrogen, 313 bushels. This increase could not be considered profitable. There is some suggestion that the higher dosage of nitrogen is somewhat more effective than the lower, if coupled with the higher dosage of phosphorus, and the optimum dosage of potash.

Five per cent phosphoric acid gave 274 bushels, 10 per cent gave 316 bushels and 20 per cent gave 342 bushels. It is obvious from these figures that phosphorus is a very important ingredient in the fertilizer.

The plots receiving no potash produced 282 bushels; those with 5 per cent potash, 327 bushels; and with 10 per cent potash, 322 bushels. It is obvious that the use of 5 per cent potash was highly profitable. In the general average, 10 per cent potash did not produce quite such good yields as 5 per cent potash. However, this general average does not represent the whole story. There is some kind of phosphorus-potash relationship, which at present is somewhat obscure.

Table 91 shows the order of yield in each year. In view of the fact that but little differences exist in yields at the two nitrogen levels, for the purpose of simplifying this table, the two levels are averaged. The table thus shows the quantities and relationships of the minerals as affecting the yields.

This table shows in a striking manner the consistent results obtained in the different years. It is plainly indicated that on this soil, and under the conditions of this experiment, a complete fertilizer high in phosphoric acid and comparatively low in nitrogen and potash is the one productive of the highest yield with the greatest economy.

STARCH CONTENT OF THE POTATOES

Through the co-operation of the Chemistry Division, Science Service, starch and moisture determinations were made on the potatoes from all plots, in 1946.

The average starch content of all plots receiving 2½ per cent nitrogen was 19.6 per cent, and for those receiving 5 per cent nitrogen, 19.8 per cent starch. Similarly, the plots receiving 5, 10, and 20 per cent phosphoric acid produced

potatoes with starch content of 19.8, 19.9 and 19.4 per cent, respectively. Thus, variations in both nitrogen and phosphoric acid levels did not appreciably affect the starch content of the potatoes.

The average starch content of all plots receiving no potash was 21.7 per cent, of those receiving 5 per cent potash, 19.1 per cent, and of those receiving 10 per cent potash, 18.2 per cent. Thus, the presence of potash lowered the percentage of starch in the potatoes, and the figures indicate that there is a greater decline in starch content between no potash and 5 per cent potash than between 5 per cent and 10 per cent potash.

MOISTURE CONTENT OF POTATOES

The moisture content of potatoes, likewise, was determined on all plots. This was not affected by either the various nitrogen or phosphorus levels, the general average of all being between 76 and 77 per cent moisture. However, the effect of potash was different: no potash, 5 per cent potash and 10 per cent potash producing potatoes of moisture content of 74.3, 77.0 and 77.9 per cent, respectively. In addition to showing the effect of potash in increasing the moisture content of the potato, the figures indicate that there is a greater increase in moisture between no potash and 5 per cent potash, than between 5 per cent and 10 per cent potash.

STARCH-MOISTURE RELATIONSHIPS

From the preceding it is shown that potash increased the moisture content of the potatoes and decreased the starch. The one does not entirely offset the other. On a dry-weight basis, the no-potash potatoes average 84.4 per cent starch and the 10 per cent potash potatoes average 82.3 per cent starch.

Active Projects

Dominion Experimental Station,
Kentville, N.S.

Horticulture

TREE FRUITS

H. 26,A,B,C	Orchard Fertilizer Experiments.
H. 755	Different Rates of 9-5-7.
*H.	Fertilizer Experiment, Berwick.
*H.	Fertilizer Experiment, Nictaux.
*H.	Effect of Unbalanced Fertilizers.
*H.	Effect of Trace Elements.
H. 331	Cultural Methods Beginning with a New-planted Orchard.
*H.	Cultural Methods Beginning with an Old Orchard.
H. 815	Tree Fruit Variety Tests.
H. 827	Tree Fruit Breeding (Apples and Cherries).
H. 836	Rootstock Experiment (East Malling Trees).
*H.	Stem Building Experiments (Tully Orchard).
H. 941	Grafting and Frameworking Experiments.
H. 810	Cider Varieties for Cider Production.
H. 840	Nut Variety Experiments.
H. 913	Grass Mixtures for Permanent Orchard Sod.
H. 767	Best Time for Picking Fruit.
*H.	Apple Thinning with Chemical Sprays.
*H.	Apple-seed Production.
*H.	Prevention of Drop of Apples with Chemical Sprays.

SMALL FRUITS

H. 21	Strawberries, Variety Experiment.
H. 327	Blueberries, Variety Experiment (Subject, Mulching).
H. 424	Blueberries, Cultivation of.
H. 793	Bush Fruits, Variety Experiment.
H. 908	Blueberries, Breeding and Selection.
H. 909	Blueberries, Propagation of.
H. 938	Cranberries, Culture of.
H. 939	Cranberries, Breeding and Selection.
H. 945	Elderberries, Breeding and Selection.
H. 949	The Improvement of the Native Low-bush Blueberry.
*H.	Bush Fruits, Cultural Tests.
*H.	Strawberry, Cultural Tests.
*H.	Grapes, Variety Trials and Method of Culture.

*Numbers not yet assigned.

VEGETABLES

H. 102	Corn, Variety Experiment.
H. 108	Herbs, Cultural Experiment.
H. 431	Tomatoes, Pruning Experiment.
H. 795	Leguminous Vegetables, Variety Experiment.
H. 802	Perennial Vegetables, Variety Experiment.
H. 803	Root Vegetables, Variety Experiment.
H. 804	Leafy Vegetables, Variety Experiment.
H. 805	Vine-crop Vegetables, Variety Experiment.
H. 806	Solanaceous Vegetables, Variety Experiment.
H. 808	Vegetables, Different Distances Apart of Planting.
H. 818	Vegetables, Seed Production.
H. 820	Vegetables, Different Dates of Seeding or Planting.
H. 821	Vegetables, Thinning Experiment.
H. 847	Vegetables, Hotbed versus Sown in the Open.
H. 848	Vegetables, Protection from Root Maggot.
*H.	Vegetables, Effect of Trace Elements.
*H.	Cultural Methods—Mulching, etc.
*H.	Hormone Treatment for Tomatoes.
*H.	Yield of Asparagus in Relation to Cutting Interval.
*H.	Nutrition Experiments with Tomatoes.

FRUIT PRODUCTS

H. 513	Fruits, Processing Methods and Variety Trials.
H. 867	Dehydration of Prunes.
H. 873	Variety Canning Test of Fruits and Vegetables.
H. 922	Fruit and Vegetable Juice Investigation.
H. 923	Utilization of Small-sized Apples.
*H.	Vegetables, Processing Methods and Variety Trials.

STORAGE

H. 838	Fruits and Vegetables, Storage Investigations.
(1)	Influence of Tree Nutrition and Stock upon Keeping Quality and Temperature Reactions of Apples.
(2)	Keeping Quality of Fruits from Uniform Trees.
(3)	Influence of Maturity upon the Keeping Quality of Fruit Stored at Different Temperatures.
(4)	Storage of Fruit in Artificial Atmospheres.
(5)	Influence of Trace Elements on Keeping Quality.
(6)	Control of Cork by Means of Boron.
(7)	Bitter Pit Investigations.
(8)	Control of Water Core.
(9)	Respiration and Manometric Studies.
(10)	Indicator Plants for Detecting Soil Differences due to Fertilizer Treatment.
(11)	Investigation of Warehouse Ventilation and Temperature.
(12)	Tomato Ripening.

*Numbers not yet assigned.

ANIMAL HUSBANDRY

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A. 59	Periodic Costs of Rearing Dairy Females.
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A. 660	Serum Tests for Contagious Abortion.
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POULTRY

P. 235	Relation of Specific Gravity to Hatching Power of Egg.
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APIARY

Ap. 7 and 8	Wintering in Bee Cellar.
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Ap. 21	Comparison of Different Sizes of Hives.
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FIELD HUSBANDRY

F. 369	Commercial Fertilizers for Pastures.
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F. 281	Chemical Weed Killers.
F. 304	Production of Ensilage from Early-cut Grass.

FORAGE CROPS

*Ag.	Growing Seeds for Cover Crops.
*Ag.	Perennial Legumes for Forage and Hay.

*Numbers not yet assigned.

OTTAWA
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KING'S PRINTER AND CONTROLLER OF STATIONERY
1949