CANADA
DEPARTMENT OF AGRICULTURE
DOMINION EXPERIMENTAL FARMS

EXPERIMENTAL STATION
KENTVILLE, N.S.

PROGRESS REPORT FOR THE YEARS 1947 to 1951

Tree using Virginia Crab as the intermediate stem-piece. Note the wide-angled crotches, also the enlarged graft unions resulting from partial incompatibility.

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EXPERIMENTAL STATION
KENTVILLE, NOVA SCOTIA

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Progress Report
Experimental Station, Kentville, Nova Scotia
1947-1951

INTRODUCTION

The Experimental Station at Kentville was established in 1911, and since that time has been mainly devoted to a study of horticultural problems of the Annapolis Valley and other agricultural areas of western Nova Scotia. At present, in addition to horticulture, limited experimental work is being conducted with poultry, animal husbandry, apiculture and field husbandry. The last published progress report from this Station was for the 10-year period 1937-46.

Along horticultural lines, the greatest amount of work is devoted to apples, though in recent years other tree fruits such as pears, plums and cherries have been given an increasing amount of attention. Small fruits, including strawberries, raspberries, blueberries, currants, gooseberries and others are continually gaining in importance, and many experiments are being carried out with these fruits. Extensive variety trials have been made with new and old varieties of many vegetables, and important cultural and breeding work conducted with tomatoes, onions, field beans and peas.

The fruit products laboratory on the Station was greatly enlarged in 1950 and is now well equipped to handle any phase of fruit and vegetable processing. Recent efforts have aimed at the development of an apple syrup for commercial production. An up-to-date cold storage plant has also recently been installed. This will provide adequate facilities for this type of experimental work.

In recent years investigations in plant nutrition have attempted to correlate by means of chemical leaf tissue analyses, the application of commercial fertilizers and abundance of soil nutrients with the keeping and processing qualities of fruits and vegetables. This promises to be an efficient modern technique for disclosing and solving many nutritional problems.

An extensive plant breeding project has aimed at producing new types of apples. The particular objective is to obtain a high quality late-keeping variety suited to the growing conditions of Nova Scotia. Efforts are also being made to produce varieties which are resistant to apple scab. A tomato breeding project has been started to develop new strains of tomatoes which will mature early and produce large quantities of high quality fruit.

The senior staff of the station are trained for specialized work in different phases of agricultural practise, and are always available to the farmers and producers of the area for consultation on problems of agriculture. Inquiries should be addressed to the Superintendent.

WEATHER

The following meteorological records are included to provide a general picture of climatic conditions of the Experimental Station.

72039—2

TABLE 1.—PRECIPITATION RECORDS, EXPERIMENTAL STATION, KENTVILLE

Monthly and Annual Precipitation Records (inches) 1947–51, inclusive, with 38-year averages and monthly extremes for the same period

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total annual snowfall	Total annual rainfall	Total annual precipitation
1947	4·71	4·33	1·92	2·65	4·26	3·66	4·25	0·86	4·67	0·40	3·41	5·48	83·2	32·28	40·60
1948	6·60	1·93	5·71	2·75	6·66	3·73	2·52	2·48	1·95	2·34	3·99	4·53	108·3	34·36	45·19
1949	2·14	3·09	5·13	2·96	2·49	2·42	0·48	4·51	3·46	1·41	4·71	3·09	61·7	29·72	35·89
1950	3·35	3·25	3·29	2·52	0·94	2·71	3·04	6·39	1·68	2·43	4·36	5·45	108·2	28·59	39·41
1951	4·08	3·22	2·20	3·71	3·27	1·20	2·94	4·79	3·75	1·47	3·58	6·08	90·6	31·23	40·29
38-year average	3·91	3·28	3·19	2·79	2·82	2·93	2·89	3·35	3·49	3·91	4·07	4·11	79·9	32·75	40·83
Extreme low for 38-year period	1·30	1·21	0·95	1·43	0·67	1·03	0·67	0·52	0·85	0·40	1·14	1·51	33·5	24·33	30·35
Year	1944	1936	1915	1918	1924	1946	1937	1934	1915	1947	1939	1943	1919	1915	1915
Extreme high for 38-year period	8·69	6·57	5·71	4·95	7·66	6·32	5·63	9·39	10·58	11·69	7·71	5·63	156·4	48·01	48·21
Year	1935	1926	1948	1946	1945	1945	1922	1927	1942	1933	1934	1934	1926	1933	1945

TABLE 2.—FROST RECORDS, EXPERIMENTAL STATION, KENTVILLE, N.S.

Frost: 32°F. or lower; killing frost, 28°F. or lower

Year	Last frost in spring		First frost in fall		Number of frost-free days	Last killing frost in spring		First killing frost in fall		Number of crop days (above 28°F.)
	Date	Temp.	Date	Temp.		Date	Temp.	Date	Temp.	
1947	June 8	29	Sept. 21	29	104	May 16	25	Sept. 29	27	135
1948	May 21	29	Sept. 30	32	131	May 20	27	Oct. 17	25	149
1949	May 22	28	Sept. 11	32	111	May 22	28	Oct. 3	28	133
1950	May 22	25	Sept. 22	29	122	May 22	25	Oct. 16	25	146
1951	May 20	28	Oct. 2	29	134	May 20	28	Oct. 14	23	146
38-year average	May 24	.....	Sept. 28	.....	126	May 6	.....	Oct. 14	.....	160
Shortest crop season, 1914	June 4	32	Oct. 1	27	118	May 2	28	Oct. 1	27	120
Longest crop season, 1917	May 12	30	Sept. 12	31	122	Apr. 20	27	Nov. 1	27	194

Earliest and latest frost dates (32° or lower) 1913-1951:
Latest spring frost—June 15, 1943
Earliest last spring frost—May 3, 1937
Earliest fall frost—Sept. 9, 1942
Latest first fall frost—Oct. 20, 1933

Earliest and latest killing frost dates (28° and lower) 1913-1951:
Latest spring killing frost—May 28, 1933
Earliest last killing frost of spring—April 17, 1916
Earliest fall killing frost—Sept. 28, 1922
Latest first killing frost of fall—Nov. 9, 1927

APPLE BREEDING

C. J. Bishop

The apple breeding work at Kentville developed as an outgrowth of an extensive pollination project carried out in the early 1930's under the direction of Dr. W. H. Brittain. As a result of this investigation a plantation was established which contained a total of 30,168 seedlings from crosses between a great many parental varieties. Through various factors of natural selection and the elimination of those seedlings with undesirable tree and fruit types, this number has been reduced to some 3,000 trees at the present time. Most of these have produced fruit and within another two years it is expected that the plantings will be further reduced to one-tenth of this number. Those saved from this severe selection process will be tested further as possible new commercial varieties.

Much variation has been found among the progeny of the different varieties used as parents. As high as 20 per cent of the progeny of some were desirable seedlings, while others have produced practically none of any value. Outstanding as prepotent parents have been the varieties McIntosh and Cox Orange, both of which produced seedlings with relatively high-quality fruit. However, McIntosh has transmitted a high degree of susceptibility to apple scab, and Cox Orange seedlings have tended to produce small apples.

Figure 1. These apple seedlings, growing in marked rows at the Experimental Station, Kentville, are from controlled crosses of varieties made to combine desirable characters evident in the fruits of the parents,—high eating and cooking quality, good keeping quality, red colour, and resistance to scab.

In order to evaluate the various parental combinations, detailed records have been kept of the fruit characters of all the seedlings of known crosses. Over the period covered by this report this has totalled between 6,000 and 7,000 seedlings. From these records it is possible to determine the relative breeding value of any of the many varietal combinations of the original project.

In addition to the required characters of good appearance and high quality, the two most desired attributes are scab resistance and late-keeping quality. A number of seedlings possessing these characteristics have shown indications of potential commercial value, but to date none has been sufficiently tested to be released as a named commercial variety.

Since 1948 new crosses have been made with certain aims in view, using for parental varieties those which have proved to give a relatively high proportion of desirable progeny. During the last four seasons 18,755 cross-pollinations have been made. Varieties used include: McIntosh, Richared Delicious, Cox Orange, Wagener, New York Red Spy, Spartan, Secor, Macoun, Cortland, Bishop Pippin, Red Rome Beauty, Golden Delicious, Sandow and a number of sports and seedlings.

The seeds from these crosses were started in the greenhouse and the young seedlings set out in the field about 10 inches apart in rows 4 feet apart. (Fig. 1). After two to three years in the nursery these will be shifted to permanent orchard plots where they will remain until they have fruited. An attempt has been made to speed up this process by frameworking the seedlings on grown trees (Fig. 2), and it is hoped that the period of time from seed to fruit may be reduced through this method by several years.

Figure 2. Apple seedlings frameworked into grown trees in order to reduce the time required to produce fruit.

New Lines of Investigation

Several new lines of investigation have been started in the apple breeding project. One of these is the search for "giant sports" of some of the commercial varieties of apples. These result from spontaneous changes in the developing bud of a branch that cause it to produce fruits which are much larger than those on the remainder of the tree. While these giant fruits are usually of no direct commercial value themselves, being often much too large, they offer unique opportunities for use in plant breeding. These giant apples are actually caused by a natural doubling of the number of chromosomes, the essential parts of the cell which carry the hereditary units, and so are distinctly different from normal apple varieties. By using these as breeding parents it is possible to develop a new method of apple breeding.

Figure 3. A tetraploid apple seedling (Baldwin × Northern Spy) at the Kentville Station. Occurring at a rate of one in a thousand or less, these rare trees are of particular value in an apple breeding program.

Figue 4. A "sectorial chimaera" of Yellow Gravenstein. Part of this apple shows a spontaneous genetic change from yellow to red colour.

Similar changes occasionally occur in seedlings in the very early stages of development in such a way that the whole seedling is of the double-chromosome-number type. Three of these have been discovered on the Station (Fig. 3) and two have produced fruit. These are the first bearing trees of their kind to be reported in North America. Cross-pollinations have already been made between these and some of the best commercial varieties with the hope of producing as many as possible of these potentially valuable, new-type apples.

A wide search is also being made for colour sports. A number of these already exist as important commercial strains of varieties, for example Crimson Gravenstein, a sport from Banks' Red Gravenstein, and Richared Delicious, a sport from the ordinary Delicious. Complete colour sports occur rarely, and more commonly only a small sector of the apple shows the increase in red colour. (Fig. 4). These partially coloured specimens have considerable potential value, nevertheless, as it may be possible to induce bud development in the branch at a point which will increase the amount of colour until it is complete. An attempt is being made to discover and propagate any of these sectorial sports which are of possible value.

One further step has been taken in this line of work through the use of X-radiation to induce these bud changes in the apple varieties Cortland, Sandow and Bishop Pippin (Yellow Bellflower). These experiments have been carried out by X-raying dormant scions and then grafting these by the framework method into grown trees. Between 4,000 and 5,000 scions have been X-rayed in this manner and the first apples were obtained from them in 1951. The results so far are limited, but suggest that X-ray-induced changes are being produced and that worthwhile sports may be obtained as a result of this work.

TREE FRUITS—APPLES

R. P. Longley

Response of Apple Trees To Various Cultural Treatments

In 1940 an experiment was begun at the Station to test six different soil cover crop treatments in apple orchards. The plan was designed to study not only the growth and productiveness of the trees but also to determine the effect of the different treatments on the qualities of the fruit.

The orchard was set to four varieties, Cortland on Malling I rootstocks, McIntosh and Golden Russet on Malling XII, and Wagener on Malling II. The rows are 20 feet apart and the trees 33 feet apart in the rows. The Cortland and Wagener rows will be removed before they crowd the others too seriously.

There are six treatments each replicated six times, giving 36 plots in all, and there are two trees of each of the three varieties in a plot. Since the beginning of the experiment a few trees have died and have been replaced. One-half of the plots are cultivated and these are divided into three cover crop treatments following early spring cultivation. The cover crops are (1) self-seeded natural weeds, (2) buckwheat and (3) annual vetch. The other 18 plots are in sod receiving three treatments. Six of them are seeded to grass, six to ladino clover, and six to a general grass seed mixture. The grass mixture receives no fertilizer but the same amount of fertilizer is applied to a field of equal size and the grass produced is used for mulch. The grass is cut usually twice during the season.

The land was clean cultivated and the 36 plots treated uniformly from 1940 to 1945. In 1946 the treatments were started.

The original plan called for 1,000 pounds of 2-12-6 fertilizer applied broadcast per acre per year. This was changed to 3-15-6 when 2-12-6 went off the market and the quantity reduced accordingly.

Difficulties have become apparent during the progress of the experiment. The trees were not equal in size when the test was started, and showed a variation from 7·2 to 70·6 sq. cm. in the size of the McIntosh trees as measured by the cross-section of the trunks. The small tree has produced one pound and the large one 272 pounds of fruit over the years. Similar variation has been found among the other varieties in the test.

Buffalo tree hopper did serious damage in the orchard. The injury was very light to the trees in the buckwheat plots and very heavy to the trees in the vetch plots. Trees in the ladino clover and weed plots were moderately damaged. Apparently the vetch, clovers and some weeds attract the adult hoppers. The buckwheat plots have had a moderate cover every year. The vetch plots have varied from a very heavy crop to a failure. The ladino clover started well, with 46 per cent of the ground covered with ladino and other small wild clovers in 1949. By 1951 the percentage had dropped to 32 per cent. The yield of herbage on the ladino plots in 1949 was double the yield of the grass plots, but in 1950 they produced only 33 per cent more than the grass plots, reflecting the effect of the changing flora.

Tables 3 and 4 give the tree sizes as measured by trunk cross-section and the cumulative average yields from 1946 to 1951. The percentage of red colour on the fruit, the size and the percentage of the crop that dropped are given in Table 5 for the year 1951.

Under the conditions of the experiment, the trees on the cultivated cover crop plots were distinctly superior to those on the grass sod and ladino sod plots. They produced about five times as much fruit as the grass sod trees and double as much as the ladino sod trees. Their rate of growth was much more rapid.

TABLE 3.—AVERAGE SIZE OF TREES UNDER DIFFERENT CULTURAL TREATMENTS

Variety	Treatment	No. of trees	Cross section of trunk 1941 (sq. cm.)	Cross section of trunk 1951 (sq. cm.)	Percentage Increase
McIntosh	Weed	11	29·0	134	360
McIntosh	Buckwheat	12	26·6	139	421
McIntosh	Vetch	11	27·5	126	356
McIntosh	Grasses	10	25·4	91	257
McIntosh	Ladino	12	31·4	117	273
McIntosh	Mulch	11	27·7	128	363
Wagener	Weed	6	18·9	45	135
Wagener	Buckwheat	11	20·6	59	185
Wagener	Vetch	10	21·7	56	157
Wagener	Grasses	12	14·1	31	120
Wagener	Ladino	11	20·9	42	101
Wagener	Mulch	10	18·3	54	194
Golden Russett	Weed	12	28·4	122	329
Golden Russett	Buckwheat	12	25·6	128	402
Golden Russett	Vetch	12	23·5	100	328
Golden Russett	Grasses	11	23·8	86	262
Golden Russett	Ladino	12	26·5	94	255
Golden Russett	Mulch	11	28·4	117	312

In the extreme, the McIntosh trees in the buckwheat plots increased in size 421 per cent from 1946 to 1951, while the grass sod plot trees increased 257 per cent. The cultivated cover crop treatments were quite similar in growth and yield, with the buckwheat plot trees definitely taking the lead. Two factors, buffalo tree hopper damage and the difficulty of securing a stand of vetch, complicate the results, but the fact that the vetch plots made such a good showing in spite of the injury from the tree hoppers is convincing evidence that if vetch could be grown and the insects controlled, outstanding benefits would be derived.

TABLE 4.—AVERAGE YIELDS OF TREES UNDER DIFFERENT CULTURAL TREATMENTS

Variety	Treatment	Cumulative yield 1946	1947	1948	1949	1950	1951
McIntosh	Weed			·02	·70	5·5	25·8
McIntosh	Buckwheat			·05	·55	5·9	25·2
McIntosh	Vetch			·01	·29	3·5	17·4
McIntosh	Grass				·01	·9	3·7
McIntosh	Ladino		·08	·10	·80	3·6	9·8
McIntosh	Mulch			·05	·62	6·6	21·5
Wagener	Weed	·17	·33	·39	·93	1·8	4·5
Wagener	Buckwheat		·44	·97	2·64	3·9	9·9
Wagener	Vetch		·54	·59	2·02	3·8	8·7
Wagener	Grass		·11	·11	·25	·8	1·9
Wagener	Ladino	·20	·82	·83	1·72	2·0	4·5
Wagener	Mulch		·51	·52	2·16	2·5	8·9
Golden Russett	Weed			·01	·33	5·8	14·3
Golden Russett	Buckwheat				·02	7·4	15·3
Golden Russett	Vetch					4·6	11·5
Golden Russett	Grass					·1	1·0
Golden Russett	Ladino		·02	·14	·31	3·5	6·0
Golden Russett	Mulch				·06	3·9	10·4

TABLE 5.—COLOUR, SIZE AND AMOUNT OF FRUIT DROP FROM DIFFERENT CULTURAL TREATMENTS, 1951.

Variety	Treatment	Percentage red colour on fruit	Weight per 100 apples (lb.)	Percentage of crop dropped
McIntosh	Weed	82·9	29·1	22·1
McIntosh	Buckwheat	80·4	29·8	18·4
McIntosh	Vetch	82·3	28·0	20·6
McIntosh	Grass	93·8	24·1	28·0
McIntosh	Ladino	92·6	26·8	23·6
McIntosh	Mulch	80·0	29·5	17·6
Wagener	Weed	75·7	29·1	15·2
Wagener	Buckwheat	75·4	32·0	7·0
Wagener	Vetch	72·3	29·7	5·3
Wagener	Grass	90·4	32·1	14·9
Wagener	Ladino	88·1	34·6	11·3
Wagener	Mulch	71·4	30·5	5·6
Golden Russett	Weed	.....	25·1	15·7
Golden Russett	Buckwheat	.....	25·1	21·8
Golden Russett	Vetch	.....	23·3	12·1
Golden Russett	Grass	.....	19·2	37·1
Golden Russett	Ladino	.....	21·4	24·0
Golden Russett	Mulch	.....	23·4	16·2

The trees in the grass and ladino plots look poor and are growing much more slowly than in the other plots. Their trunk measurements show them to be about one to two years behind the others but their general appearance suggests that they will never be happy under the present cultural and fertilizer treatment. The symptoms are those of nitrogen starvation, and indicate that the amount of nitrogen in the fertilizer is too small for normal tree growth under these conditions. The difference in size of these trees would account for much if not all of the difference in yield. As yet, the experiment has not continued long enough to give very reliable yield data.

Up to 1950 the amount of mulch applied to the mulch plots was very light. The plot that produced the mulch was ploughed in September 1949, and was seeded to rye and grass seed. The rye was used for mulch in 1950 and an excellent crop of clover was produced in 1951. While the trees are somewhat smaller than those in the cultivated plots they are growing and producing well. These trees are on flat land where erosion is negligible. If there was a slope the mulch culture would protect the soil from loss.

It is not considered that the fruit size data are of much value. Generally the grass and ladino plots produced smaller fruits but the Wageners in 1951 in these plots had very good sized fruits. All Wageners were thinned in 1951. The colour is generally best where the tree growth is least, with the mulch plots producing the greenest fruits and the grass and ladino plots the reddest. All fruit had excellent colour in 1951.

The drop apples were gathered at picking time and recorded. It was found that generally the percentage drops was in proportion to the amount of red colour on the fruit. The grass and ladino plots had the highest proportion of drops. Apparently they matured earlier, producing extra red colour and showing a greater tendency to drop.

The data justify the conclusion that clean cultivation followed by a cover crop of buckwheat is the best treatment tested. To date, the natural weeds have proved satisfactory as a cover crop, even if not quite equal to buckwheat. If a strain of vetch could be found that would give a good stand, this might prove superior, but the results of this test place it in a position about equal to natural weeds. It seems reasonable to expect that mulch plots will take the

lead when a moderate amount of this material is applied. The amount applied in 1951 was sufficient to reduce colour on the fruit but was applied too late to materially change the growth rate of the trees.

Rootstock Test

The orchard known as the "Malling Block" has continued to attract considerable attention because of an increased concern over rootstocks and the possibility of securing mature trees of smaller size than the mature trees on seedling rootstocks. It contains McIntosh and Fameuse on four Malling rootstocks (M I, M II, M IX and M XII), and two seedling rootstocks, Anis and Beautiful Arcade. The trees were set in 1934.

When examined, it was found that all Fameuse and practically all McIntosh trees on M IX rootstocks had scion rooted. Many were developing as free growing trees, and while smaller than the others owing to the early effect of the dwarfing rootstocks, were growing rapidly. They are not included in this report. One lesson to be learned from them is that trees on this particular rootstock must be carefully planted and cultivated so the union will remain above ground level. Trees on the other rootstocks, Malling I, II, XII, Anis seedlings and Beautiful Arcade seedlings are in a healthy condition and no scion rooting was found.

Biennial Bearing

The trees in the orchard have developed the biennial bearing habit with nearly all trees producing their heavy crop the same year. The yield of Fameuse in 1948 was only 12 per cent of the 1949 crop, and in 1950, 21 per cent of the 1951 crop. Comparative figures for McIntosh are 23·3 and 43·7 per cent. In the development of the biennial habit no significant differences were found between rootstocks.

Size Ratios

Size differences between trees on the different rootstocks are important. They are shown in Table 6. Trees of both varieties are larger on Malling XII rootstocks than on the others. The M II rootstocks produced the smallest trees, being 56·4 per cent of the size of the trees on M XII in the instance of McIntosh and 64·3 per cent in Fameuse. The Fameuse trees on the other three rootstocks are very similar in size, being about 75 per cent the size of Malling XII trees. The McIntosh trees on M I are somewhat smaller than on Anis and Beautiful Arcade seedling roots. This is probably a varietal reaction as the response is different in the case of Fameuse on M I.

TABLE 6.—AVERAGE TREE SIZE McINTOSH AND FAMEUSE ON DIFFERENT ROOTSTOCKS

Variety	Root-stock	No. of trees	Height feet	Average spread (feet)	Trunk cross-section 1951 (sq. cm.)	Trunk growth 1950 to 1951 (per-centage)	Size ratio with Malling XII (per-centage)
McIntosh	M I	16	16·8	26·6	365	7·7	67·2
McIntosh	M II	16	14·7	24·3	306	6·8	56·4
McIntosh	M XII	16	17·6	29·2	543	9·9	100·0
McIntosh	Anis	16	16·8	27·3	428	8·8	78·8
McIntosh	Beautiful Arcade	14	16·5	26·9	414	7·7	76·2
Fameuse	M I	15	17·7	27·5	433	6·9	72·5
Fameuse	M II	16	15·4	25·4	384	7·6	64·3
Fameuse	M XII	16	18·8	29·5	597	8·3	100·0
Fameuse	Anis	15	16·6	27·2	450	8·1	75·4
Fameuse	Beautiful Arcade	16	16·2	25·5	423	7·4	70·9

The rate of growth of trunk indicates that the M XII trees are continuing to grow at a faster rate than any of the others so the spread in size will continue to widen. The M II McIntosh trees are small and growing slowly. Fameuse trees on M II are slightly larger and their rate of growth is about average. Apparently the rootstocks have a variable dwarfing effect on trees of different varieties. The data on height and spread of trees are also recorded in Table 6, and show that differences in spread are not uniform.

Yields

The yield data are presented in Table 7, with the yield shown for four periods in one of which (1951) the crop was very heavy. For a correct interpretation the yields must be studied along with the tree sizes. The M XII trees were slower coming into bearing than any of the others, but the Fameuse trees on M XII are now leading in production, and McIntosh on M XII are near the average. Trees on M II are smallest in size and lowest in yield. The McIntosh trees on Beautiful Arcade far outyield the other rootstocks, and Fameuse trees on this rootstock are only slightly below the leading M XII trees.

TABLE 7.—AVERAGE YIELDS OF McINTOSH AND FAMEUSE ON DIFFERENT ROOTSTOCKS

Variety	Rootstock	No. of trees	Average yields, pecks					Yield per 100 sq. cm. cross-section
			1938 to 1942	1943 to 1946	1947 to 1950	1951	Total	
McIntosh	M I	16	8·83	47·6	79·8	48·9	185·2	50·7
McIntosh	M II	16	8·30	39·5	60·1	35·0	142·9	46·7
McIntosh	M XII	16	6·81	49·9	101·7	48·9	207·4	38·2
McIntosh	Anis	16	8·87	53·8	99·2	56·7	218·6	51·1
McIntosh	Beautiful Arcade	14	16·49	71·2	108·9	53·3	249·9	55·4
Fameuse	M I	15	4·70	36·2	85·3	70·2	196·4	45·4
Fameuse	M II	16	8·22	38·7	77·5	60·2	184·7	48·1
Fameuse	M XII	16	·87	33·4	88·7	90·3	213·2	35·7
Fameuse	Anis	15	2·68	34·1	73·3	71·1	181·1	40·2
Fameuse	Beautiful Arcade	16	3·14	39·3	88·8	76·7	208·0	49·2

When yields are compared by using the cross-section of trunk as the measure of size, the Beautiful Arcade trees lead in both varieties. M XII trees in relation to their size, have the lowest yield in both varieties, having produced less than three-quarters the amount from the Beautiful Arcade seedling trees.

Colour

Considerable work has been done to compare the fruit size and amount of red colour of the fruit. It is noticeable that the very vigorous M XII trees produce fruit with less colour than the others. Differences in fruit size were small and not significant.

In conclusion the use of Beautiful Arcade seedling roots resulted in very productive moderate sized trees. Among the smaller trees, those on M II rootstocks showed an early advantage, although they have not yielded as well as trees on Beautiful Arcade roots. The M XII trees at 18 years of age are very large and are still growing rapidly.

Frameworking Apple Trees

An experiment and demonstration begun in 1942 on frameworking apple trees has proved a very timely guide for an extensive grafting program in this district. The development of the trees over the years has added information making possible further evaluation of the work.

The original experiment was carried out on Red Stark trees set in 1930, on Malling I, II and XVI rootstocks. These were frameworked to Crimson Gravensteins in 1942 and their development compared with other trees of Crimson Gravenstein set at the same time on the same rootstocks and receiving the same cultural treatment. A comparison of these gives information on the loss of crop resulting from frameworking.

The data available, while not complete, show that the Stark and Gravenstein trees were nearly the same size previous to frameworking. The Starks and Gravensteins on Malling I roots yielded up to 1942 within two per cent of each other. The Gravensteins on Malling II rootstocks outyielded the Starks, while the situation was reversed in the case of the Malling XVI rootstocks. Table 8 gives the average yearly production of the trees since that date.

It will be noted that with the exception of some years when the yields were low, the trees which were not frameworked have continued to produce more heavily than the frameworked trees, the difference in total being 100 pecks (nine barrels) for Malling I and XVI trees and half that for the smaller Malling II trees. The differences since 1948 have been small.

It is suspected that the trees not frameworked had an advantage in soil in the instance of Malling II and XVI trees. The soil conditions appeared uniform where the Malling I trees were growing, so these are possibly the more reliable figures.

The scions for the frameworking, secured from a grower's orchard, apparently were mixed and colour determinations for this reason were not considered reliable. It is possible, although improbable, that yields could also be affected by the strain of Crimson Gravensteins used.

The information indicates that under the conditions of this experiment, in addition to the cost of scions, wax and labour, there was a reduction of yield amounting to about 50 per cent for a 7- to 10-year period.

TABLE 8.—A COMPARISON OF CRIMSON GRAVENSTEIN YIELDS IN STANDARD AND FRAMEWORKED TREES

Treatment	Number of trees	Root-stock	Yield to 1941 pk.	Yields, in pecks											Relative yields for 10 years
				1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	total (1942-51)	
Standard.....	12	M I	53·5	5·3	23·8	27·8	0·1	38·5	6·7	33·2	2·3	59·8	16·4	213·9	100·0
Frameworked.....	13	M I	54·0	.....	.....	9·7	.....	20·9	9·3	18·2	5·1	52·8	10·4	126·4	59·6
Standard.....	5	M II	25·1	0·2	6·0	14·4	.....	19·3	2·3	16·5	0·7	26·2	5·6	91·2	100·0
Frameworked.....	5	M II	16·4	.....	.....	5·4	.....	5·0	1·4	8·9	1·2	23·2	3·3	48·4	53·1
Standard.....	3	M XVI	58·6	2·3	11·8	27·0	.....	34·4	3·7	30·5	3·3	62·7	9·2	184·9	100·0
Frameworked.....	7	M XVI	75·4	.....	.....	1·0	.....	1·8	4·3	10·8	4·4	55·1	4·5	81·9	43·2

Apple Tree Stembuilding

The practice of using special varieties for apple tree trunks has received limited attention in Nova Scotia. This is probably because winter hardiness in apple trees is rarely considered a problem in this fruit section. Even so, a test was begun in 1939 by setting trees of the varieties Haas, Hibernal and Virginia Crab to be used for topworking. The branches of these were frameworked in 1942 to five varieties, Wagener, Cortland, Starking Delicious, Golden Delicious, and Red Spy. The resulting trees thus contained commercial varieties in the branches and a hardy trunk, all on a relatively uniform rootstock.

Measurements of the trunk cross-section have been made each year since 1947 and yield records taken since the trees started bearing.

At the time of frameworking in 1942, the tree differences were quite distinctive. The Virginia Crab trees were considerably larger than the others with wide-angled crotches appearing like excellent trees for frameworking. The Haas trees were small and had very narrow-angled crotches, (Figure 5) the kind fruit growers try to avoid. The Hibernal trees had wide-angled crotches and were intermediate in vigour between the Haas and the Virginia Crab. These characteristics were in evidence in 1947 when size records were first taken.

Figure 5. Tree using the variety Haas as the intermediate stem-piece. Note the undesirable narrow crotches.

It was recognized early in the study that the Virginia Crab stems were incompatible with several of the scion varieties used. While in 1947 these trees were still the largest, reflecting the effect of the greater size when frameworked,

this early advantage has now been lost and the trees with Hibernal and Haas stem pieces have exceeded them in size. In Red Spy, for example, the growth from 1947 to 1951 was 84 per cent on Crab trunks as measured by trunk cross-section while the Haas and Hibernal trees frameworked to Spy increased in size 263 and 207 per cent respectively.

The trees with Virginia Crab trunks likewise very early took the lead in fruit production. This probably resulted from the effect of the restricted growth, and was not a uniform condition between varieties.

The Golden Delicious have grown quite normally and appear healthy. They have produced well and yields from those on the Virginia Crab stems have been about 65 per cent more than those from the trees on the Haas and Hibernal stem-pieces. Even so, their rate of growth has slowed down, the increase in trunk cross-section from 1947 to 1951 being 107 per cent in comparison with 165 and 134 per cent for Haas and Hibernal trees. This could result in part from a normal decrease in rate of growth as the trees get larger. The Golden Delicious trees on Virginia Crab were considerably larger in 1947 than those on Haas and Hibernal.

While the Wagener trees on Virginia Crab look healthy and have produced better than the Wageners on Haas and Hibernal their rate of growth has been much slower.

The Cortland and Starking Delicious trees on Virginia Crab stem-pieces have grown slowly. Though showing an original advantage on Virginia Crab, both these varieties are now giving higher yields on Haas and Hibernal.

Measurements of tree height and spread were taken in 1951. This as well as the cross-sectional areas are given in Table 9. This shows that the trees on Viriginia Crab are lower and more spreading than those on the other stems. The Golden Delicious trees show the least effect.

TABLE 9.—TREE SIZES OF VARIETIES DOUBLE-WORKED ON HAAS HIBERNAL AND VIRGINIA CRAB STEMS

Trunk	Variety	No. of trees	Trunk cross-section		Per cent increase	Tree dimensions	
			1947 (sq.	1951 cm.)		Average Spread (Ft.)	Height (Ft.)
Haas	Wagener	12	23·8	56·7	138	9·9	12·3
	Cortland	11	33·6	91·5	172	15·4	11·6
	Starking	9	22·0	60·3	174	16·1	11·9
	Delicious	11	41·8	110·6	165	16·3	13·6
	Red Spy	13	32·6	118·4	263	14·7	15·0
Hibernal	Wagener	8	28·8	71·8	149	11·8	13·0
	Cortland	8	37·2	95·5	157	15·5	11·4
	Starking	10	27·0	73·0	170	16·4	12·0
	Delicious	13	49·6	116·0	134	15·8	13·2
	Red Spy	18	33·1	101·6	207	15·1	14·4
Virginia Crab	Wagener	8	34·4	63·6	85	12·8	10·4
	Cortland	8	36·6	62·1	70	12·5	9·1
	Starking	12	27·9	47·0	68	13·0	8·8
	Delicious	13	65·5	135·3	107	17·3	12·4
	Red Spy	16	34·4	63·2	84	13·4	10·6

This experiment indicates that while the Virginia Crab stem-piece had the effect of dwarfing the trees and causing early bearing, later development has been definitely undesirable in the case of Spy, Cortland and Starking Delicious. The Golden Delicious and Wagener trees showed no noticeable ill effects.

The type of crotch found in the Haas trees is poor. To date no damage has resulted but as the trees grow there is a probability of trunk splitting. The trees with Hibernal stem-pieces are, on the average, the largest and they have produced more than the smaller Haas trees. This study suggests that the Hibernal variety is the most promising as an intermediate stem-piece.

TABLE 10.—AVERAGE YIELD OF VARIETIES DOUBLE-WORKED ON HAAS, HIBERNAL AND VIRGINIA CRAB STEMS

Trunk	Variety	No. of Trees	1946	1947	1948	1949	1950	1951	Total
Haas	Wagener	12	.....	0·3	0·2	1·2	2·2	1·2	5·1
	Cortland	11	.....	0·5	1·6	2·1	7·3	5·7	17·3
	Starking	9	.....	0·1	0·1	0·1	1·1	5·4	6·8
	Delicious	11	0·8	1·8	1·9	4·8	6·2	14·9	30·5
	Red Spy	13	.....	.....	.....	0·2	1·2	5·5	6·9
Hibernal	Wagener	8	0·3	1·1	0·4	2·3	4·5	3·6	12·1
	Cortland	8	0·2	0·6	1·5	3·7	9·4	8·6	23·9
	Starking	10	.....	0·1	0·1	0·1	1·5	6·4	8·0
	Delicious	13	2·0	2·6	3·5	4·0	9·5	8·5	30·2
	Red Spy	18	.....	.....	0·1	0·1	2·0	6·4	8·5
Virginia Crab	Wagener	8	1·3	2·6	0·8	4·2	5·9	2·1	16·8
	Cortland	8	1·6	3·3	4·6	5·2	6·5	4·9	26·0
	Starking	12	0·7	0·1	0·3	0·2	1·4	3·5	6·1
	Delicious	13	5·0	6·2	3·9	8·9	14·3	11·9	50·3
	Red Spy	16	0·3	1·4	0·7	2·1	2·6	6·8	13·8

The Effect of Heavy Application of Standard Orchard Fertilizer to Apple Trees

In order to secure information on the effect of heavy dosages of fertilizer on apple trees, a test was begun in 1939 in an orchard of Baldwins, Kings and Wageners. Three rows each of Baldwin and Wagener, and one of King were divided into three plots, one receiving no fertilizer, one 800 pounds of 9-5-7 per acre per year, and one 1600 pounds per year. The orchard was clean cultivated up to and including the beginning of the test. In 1940 it was seeded to a grass and clover mixture and has been in sod since then. The grass largely died out, but in 1949 and 1950 a lush clover and grass cover came in naturally on practically all the land.

The orchard has had standard care in respect to pruning, cutting grass and spraying. No thinning of the fruit was carried out. Red mite and codling moth have been the most serious pests. Tree sizes as indicated by measurements of the trunk cross-section have been taken since 1948. Fruit colour and size have been determined by sampling methods since 1948. Samples of 100 apples were taken from the picked apples of each tree. A summary of the information secured is presented in Tables 11 and 12. The yield of the trees for the period before the test was started is given as an approximate measure of their potentialities.

Yields

The yield of Baldwins and Wageners was increased materially by the moderate application of fertilizer when compared with the no-fertilizer-plot trees. Further, the second increment of 800 pounds increased the yield almost as much as the first. The King trees did not react in the same way. The moderate application of 800 pounds per acre caused a doubling of the yield over the no-fertilizer-plot trees, but the heavy dosage produced no increase over the moderate application. If quality of fruit is not considered, the yield of fruit would strongly justify the heavy applications of fertilizer.

TABLE 11.—SIZE AND YIELD OF TREES AS INFLUENCED BY YEARLY APPLICATIONS OF 9-5-7 FERTILIZER

Variety	Date of planting	No. of trees	Rate of yearly fertilizer application (lb. per acre)	Trunk cross-section 1951 (sq. cm.)	Average yield	
					Before 1939 (pks)	1939 to 1951 (pks)
Baldwin	1915	8	0	1356	272	316
Baldwin	1915	9	800	1623	240	440
Baldwin	1915	4	1600	1630	285	565
Baldwin	1917	1	0	1045	275	328
Baldwin	1919	1	0	990	186	243
Baldwin	1919	1	800	1150	204	404
Baldwin	1919	7	1600	1317	166	538
King	1919	4	0	1018	207	276
King	1919	4	800	1143	252	563
King	1919	3	1600	1180	229	529
Wagener	1915	10	0	690	271	209
Wagener	1915	8	800	801	272	324
Wagener	1915	6	1600	975	283	430
Wagener	1917	5	0	*662	249	*172
Wagener	1917	8	800	*816	269	*268
Wagener	1917	7	1600	*836	268	*322
Wagener	1924	1	0	*420	45	*86
Wagener	1924	2	800	*395	59	*142

* Wagener fillers removed 1949.

Tree Size

Assuming the trees were of equal size when the test started, the fertilizer applications definitely increased the growth of the trees. The no-fertilizer-plot trees grew the least and the heavy-application-plot trees the most.

Colour

In general the red colour on the fruit was in inverse ratio to the amount of fertilizer applied but these differences were not constant from year to year. To some extent this irregularity could have been caused by a variation in the classification of colour from day to day, and to a greater extent from year to year, even though these were all made by one person. The colour was much more intense on the solid red apples than on the ones with only a small amount of drab red. The no-fertilizer trees were more open than the others, as high applications caused heavy leaf and twig growth. The fruit from the 1,160-pound plots, particularly of Wageners, was unattractive, the undercolour being green rather than yellow. This test thus gives strong evidence of the serious reduction in red fruit colour when heavy applications of orchard fertilizers are made.

Fruit Size

The effect of the fertilizer on fruit size was rather variable, and was more marked in 1951 than in 1950. The Baldwins were increased in size by the applications of fertilizer while Wageners were largest on the trees which received no fertilizer and smallest on trees that had a heavy application. In the latter case high fertilizer applications probably caused a heavier set with less June drop, thus resulting in smaller size of fruit. Observations on

the biennial bearing of the trees show no indications that the heavy applications of fertilizer have reduced this condition. On the contrary it seems to have intensified this habit.

TABLE 12.—FRUIT SIZE AND COLOUR AS INFLUENCED BY YEARLY APPLICATIONS OF 9-5-7 FERTILIZER

Variety	Fertilizer application	Percentage red colour on fruit			Weight per 100 apples, 3-year average (lb.)
		1948	1950	1951	
Baldwin	0	.....	70·2	73·9	18·8
Baldwin	800	.....	45·3	58·7	22·8
Baldwin	1600	.....	31·4	51·4	24·8
King	0	71·9	79·2	81·8	41·3
King	800	58·3	59·4	74·6	38·2
King	1600	55·8	48·0	63·0	40·5
Wagener	0	71·6	77·4	82·6	24·7
Wagener	800	50·5	46·3	67·9	23·2
Wagener	1600	37·1	41·0	49·1	21·5

Note:—The apples weights for Baldwin are for 2 years only.

In conclusion, while heavy fertilizer application may possibly be of value for producing process apples in large quantity, it is not recommended for growing high quality, well coloured fruit.

The Use of Sprays to Control the Drop of Apples

Consumer demand for high-quality, attractive fruit has caused producers to leave apples on the trees as late as practical, in order to secure the desired maturity, finish and colouring. One problem introduced by this practice is the tendency for apples to drop when nearing maturity.

In 1951 limited tests to control dropping were made with a new material, "Color Set 1004", and with Parmone, which has been in general use for some years. Both were used at the recommended strengths on Gravenstein and McIntosh. The Gravensteins were mature trees capable of producing up to 30 bushels of apples and the McIntoshes young trees 12 years old yielding up to 5 bushels.

The spray was applied to the Gravensteins a few days before the normal picking date. A heavy drop of imperfect apples, resulting from mouldy core, insect injury and other causes is usual with this variety. The drops gathered before the sprays were applied were 16.6 per cent of the total crop. The data suggest that both materials were effective quickly, but that the effect from Parmone was not long-lasting. The Parmone-sprayed trees were soon losing apples as fast as the control trees, while the Color Set-sprayed trees had very limited losses until the time of picking. These results are shown in Table 13.

With the McIntosh trees, periodic collection of drops showed that there was little difference in the effect of the two sprays until October 18, when Color Set showed much less loss. When the last collection was made on October 23 the Parmone-sprayed trees were dropping heavily, and the loss then was equal to that from the unsprayed trees. However, the early advantageous effect held the total loss from the Parmone-sprayed trees considerably below the total loss from the control trees. The Color Set-sprayed trees continued to have very little loss of fruit.

When the trees were picked on October 23 all apples let go readily and it was difficult to pick them without causing dropping. A slight breeze would have caused nearly a complete loss of apples.

No attempt was made to estimate the difference in yield or value due to leaving the apples on the trees, but colour was very high at picking, the fruit stored well and had a superior flavour.

It was concluded that Parmone was of value in reducing loss for a short period with Gravenstein, and a full two weeks with McIntosh. The effect of Color Set continued until picking with both varieties, although all McIntosh seemed ready to drop when they were picked, two weeks later than normal picking time.

TABLE 13.—THE INFLUENCE OF PARMONE AND COLOR SET 1004 ON APPLE DROP IN GRAVENSTEIN AND McINTOSH, 1951

Variety	Treatment	No. of trees	Total crop (lb.)	Percentage of drops
Gravenstein	Color Set 1004	2	1303	9·4
	Parmone	3	1889	18·8
	Control	3	2152	25·5
McIntosh	Color Set 1004	12	1362	15·1
	Parmone	11	542	40·5
	Control	7	514	50·5

Note.—Sprays applied to Gravenstein (37-year-old trees) Sept. 15, to McIntosh (12-year-old) Sept. 27.

Pears

A. T. Burgher

During recent years a number of new varieties of pears have been added to the pear variety orchard at the Kentville Station. Some of these show promise of becoming good commercial sorts in the Annapolis Valley. Old established varieties such as Clapps Favorite and Bartlett will no doubt retain their high popularity for many years to come, but there is at present a need for a sequence of high quality canning and dessert pears to follow Bartlett.

The following are some of the newer pears showing promise as possible commercial varieties: Russett Bartlett, Beierschmitt, Ewart and Cayuga. Three new varieties having possibilities for the home garden and for roadside markets are Doyenne d'Ete, Giffard and Worden Seckel.

In Table 14 are listed all the varieties of pears on test at the Experimental Station in 1951.

Plums

Research on plums has been limited to variety testing. Seventy-five varieties are in the test orchard besides three numbered selections. The most promising of the new varieties are June Blood, Becky Smith, Early Laxton, California Blue, Clyman, Santa Rosa, Maynard, Mallard, Michelson, Street, Reeves, Victoria, Maglio, Yakima and Albion.

A number of varieties have been tested and are considered inferior or lacking in some quality such as winter hardiness or disease resistance. It is recommended that they be avoided in plum plantings. These are Beauty, Formosa, Grenville, Red Wing, Monitor, Waneta, Hanska, City of Naples, Cardinal, Meniger, Opato, Sapa and Elephant Heart. Monitor and Waneta appear to be suitable for colder areas because of their hardiness.

TABLE 14.—PEAR VARIETIES AT KENTVILLE, 1951

Variety	Year planted or grafted	Total yield to date	Relative date of ripening	Dessert quality	Canning quality
		pk.			
Doyenne d'été	1946	8·50	Aug. 12	Good	.....
Giffard	1946	17·50	Aug. 21	Fair	.....
Clapps Favorite	1942	6·75	Sept. 18	V. good	Good
Bartlett	1942	6·00	Sept. 27	Good	V. good
Beierschmitt	1949	4·00	Nov. 30	Good	Fair
Russett Bartlett	1946	7·12	Oct. 12	Good	V. good
Ewart	1940	13·30	Oct. 15	V. good	Fair
Flemish Beauty	1946	7·00	Oct. 15	Good	Good
Pulteney	1940	16·25	Oct. 18	Poor	Fair
Sheldon	1940	4·85	Oct. 28	V. good	Good
Anjou	1940	5·75	Nov. 7	Good	Poor
Caywood	1942	2·50	Nov. 4	Poor	Fair
Louis Bonne	1946	3·00	Nov. 3	Fair	Good
Winter Nelis	1943	2·50	Nov. 8	Good	Fair
Covert	1941	19·60	Oct. 31	Fair	Fair
Howell	1943	3·37	Nov. 5	Fair	Good
Bosc	1946	4·50	Nov. 6	Good	V. good
Phelps	1940	6·00	Nov. 3	Poor	Poor
Conference	1943	2·25	Oct. 26	Fair	Fair
Cayuga	1940	10·50	Oct. 29	Good	V. good
Durandeau	1943	6·25	Nov. 4	Poor	Fair
Dumont	1941	9·62	Nov. 4	Fair	Good
Worden Seckel	1946	1·50	Nov. 1	Good	Good
Comice	1946	0·75	Nov. 6	Good	.....
Clairgeau	1946	1·65	Nov. 7	Fair	Fair
Chaumontelle	1942	1·62	Nov. 14	Fair	Poor
Ovid	1940	13·85	Nov. 14	Fair	Fair
Waite	1941	1·25	Nov. 14	Poor	.....
Dana Hovey	1946	2·50	Nov. 12	Good	Fair
Clyde	1940	9·25	Nov. 15	Fair	Fair
Kieffer	1941	34·25	Nov. 8	Poor	Fair
Willard	1940	17·00	Nov. 21	Fair	Fair

Note—The varieties are listed in order of harvesting.

Recommendations: The following are recommended as a seasonal succession of varieties for western Nova Scotia and other sections of the province that escape severe winter temperatures: June Blood, Becky Smith, Early Laxton, California Blue, Clyman, Santa Rosa, Burbank, Mallard, Street, Washington, Peters Golden Gage, Albion, Shropshire Damson, Stanley and Grand Duke.

Summarized Descriptions

Plums may be classified into several different groups (Table 15), depending on their botanical origin. The European group (*Prunus domestica*) is indicated by D; the Japanese (*Prunus solicina*) by S; the Davison (*Prunus insititia*) by I; and hybrids by H.

Under variety, those marked with an asterisk were planted in 1940, all others in 1942. Winter hardiness was estimated after the test winter of 1950-51. A "10" indicates near perfect hardiness under the conditions of that winter, while smaller figures indicate relative lack of hardiness.

TABLE 15.—PLUM VARIETIES AT KENTVILLE, 1951

Variety	Class	Colour	Quality	Weight per 100 fruits	Yield per tree since planting	Winter hardiness	
						Tree	Blossom buds
				oz.	qt.		
Beauty	S	Red	Fair	57	63	5	0
June Blood	S	Red	Fair	97	83	7	1
Becky Smith	S	Red	Fair	68	53	3	0
Early Laxton	D	Yellow	Good	58	48	10	10
*California Blue	D	Blue	Good	134	55	10	4
*Clyman	D	Blue	Good	59	151	10	10
Formosa	H	Red	Fair	140	24	6	0
Santa Rosa	H	Red	Fair	95	36	7	0
Maynard	H	Red	Fair	138	56	10	2
*Grenville	H	Red	Poor	116	21	9	10
Burbank	S	Red	Good	70	105	9	5
*Laxton Bluetit	D	Blue	Good	88	56	?	3
*DeMontfort	D	Blue	Good	78	60	10	4
*Mallard	D	Red	Good	154	75	8	4
Tragedy	D	Blue	Good	102	87	9	0
Michelson	D	Blue	Good	74	60	10	3
*Red Wing	H	Red	Poor	118	15	8	10
*Street	D	Red	Good	152	105	9	6
*Reeves	D	Red	Fair	158	308	9	8
Monitor	H	Red	Poor	149	68	10	10
*Waneta	H	Red	Poor	114	243	10	10
*Hanska	H	Red	Fair	89	171	5	10
*Victoria	D	Red	Good	201	63	9	6
*Spaulding	D	Yellow	Good	62	123	10	1
Maglio	S	Red	Fair	149	80	3	1
Washington	D	Yellow	Good	156	84	10	10
Peter's Golden Gage	D	Yellow	Good	140	107	10	8
City of Naples	D	Yellow	Good	54	90	8	3
*Yakima	D	Red	Good	190	127	10	4
*Hall	D	Blue	Good	165	37	8	1
Yellow Egg	D	Yellow	Fair	123	55	9	4
*Albion	D	Blue	Good	121	152	9	3
Shropshire Damson	I	Blue	Good	40	65	10	5
Mammoth	H	Red	Poor	100	30	6	0
*Stanley	D	Blue	Good	108	67	10	7
Pacific	D	Blue	Good	139	8	10	10
Monarch	D	Blue	Good	115	71	8	1
*Sannois	D	Blue	Good	65	93	9	?
Grand Duke	D	Blue	Good	121	74	9	1
Imperial Epineuse	D	Blue	Good	103	20	10	10
Reine Claude	D	Yellow	Good	135	56	5	5
Italian Prune	D	Blue	Good	71	22	10	10
*Latz German Prune	D	Blue	Fair	97	159	10	6
*Elephant Heart	S	Red	Good	200	6	6	3

Note—Varieties are arranged in order of their picking dates (August 10 to October 5).

Peaches

Even though peaches are not recommended for commercial planting in Nova Scotia there is considerable interest in them and an increasing number are being set. In order to be able to suggest the most promising types, a collection of 51 varieties and three numbered selections are on test. A full crop was

harvested in 1949, and a good crop in 1950. Low temperature in January, 1951, caused a complete loss of blossom buds. Trees were somewhat damaged but most of them recovered and subsequently made good growth.

The following varieties arranged in order of ripening have been found to combine productiveness and moderate tree hardiness, with size, quality and attractiveness of fruit: Marigold, Oriole, Golden Jubilee, Vedette and Veteran.

The season range represented is from Marigold, which is usually ready for picking the third week of August, to Vedette and Veteran, which reach maturity the middle of September.

Of the newer introductions under test which have fruited, the following varieties show the most promise: Jerseyland (early), Dixigem and Triogem (both midseason).

SMALL FRUITS

D. L. Craig

In the past small fruit work at this Station has been devoted mainly to variety testing and cultural experiments. Present plans are for further breeding work covering all kinds of small fruits in an attempt to produce varieties better adapted to local conditions.

Strawberries

Variety Test

Twenty-four varieties randomized in replicated blocks are under test at present. New introductions are added to the test as they become available. Other varieties are deleted when they prove themselves unproductive, of poor quality, susceptible to disease or low in vigour. Forty-two varieties have been tested during the five-year period covered by this report.

Senator Dunlap, Premier and Pathfinder are recommended as early to midseason varieties, Catskill midseason, Sparkle midseason to late, and Louise as a late season variety.

In the Chebogue area of Yarmouth County only the variety Jessie performs well.

TABLE 16.—FIVE-YEAR AVERAGE YIELDS OF RECOMMENDED VARIETIES 1947-1951

Variety	Yield per acre (quarts)	Season
Catskill	10,800	Midseason
Premier	8,981	Early to midseason
Pathfinder	8,937	Early to midseason
Sparkle	7,862*	Midseason to late
Senator Dunlap	7,089	Early to midseason
Louise	7,014**	Late

* Two-year average
** Three-year average

Mulching Strawberries

A test to determine the necessity of mulching strawberries when grown on a light type of soil was begun in 1949. The variety Catskill is being used in this experiment and the treatments are three non-mulched plots, three straw-mulched plots, three sawdust-mulched plots and three plots having oats sown between the rows in early September. To date the plots have not shown any significant difference in yields or in winter injury to the plants. However, the mulches tend to delay fruiting and to extend the fruiting season by two to three days.

Growing Strawberries on the Hill System

A project to determine the feasibility of growing strawberries on the hill system was begun in 1950. Varieties such as Fairfax which produce new plants at very short distances along the stolons bloom heavily but set poor crops from an apparent lack of moisture. The varieties Fairfax, Catskill and Sparkle were included in the test. Only one crop has been harvested and it was very light when compared, on the per-plant-set basis, with the matted row. Full

production will not be obtained until the third fruiting year. By that time, there will be an indication as to whether or not strawberries can be grown profitably on the hill system as is done in British Columbia.

Strawberry Plant Improvement Program

In co-operation with the Provincial Department of Agriculture, this Station has for the past few years been carrying on a strawberry plant improvement program. To date, this program has been largely one in which the growers, by the use of carefully rogued clonal plants, have attempted to improve their own stock. A measure of the success of this program is indicated in our own variety plot yields when in 1949 the old stock of Senator Dunlap and Premier was discarded and replaced by clone grown stocks. A remarkable increase in yield and size of fruit resulted, especially with the variety Senator Dunlap.

Further plant improvement work revolves around the virus disease problem that apparently exists. During 1951 the provincial entomological staff made a thorough survey of the insects inhabiting strawberry fields. Which, if any, of these insects spreads the virus is yet to be determined. The ultimate goal is the production of virus-free stock through indexing, insect control and isolation, or inherited resistance to the disease.

Strawberry Breeding

The small-scale strawberry breeding program which began in 1949 has resulted in the selection of eighteen superior plants from the several thousand seedlings raised. These selections are from Fairfax × Valentine, Valentine × Fairfax and Catskill × Fairfax crosses, and it will be necessary to test them for several years before releasing them to growers. In the meantime, other crosses are being made, with the hope that a productive high-quality, early-fruiting variety as well as midseason and late-fruiting sorts superior to those now being grown can be produced.

True hybrids were obtained from a *Fragaria vesca* var *alba* × Fairfax cross. Although nearly 100 per cent sterile, a few achenes developed and were saved. From them an F_2 population will be raised with the possibilities of obtaining some fertile and valuable individuals.

Raspberries

Variety Test

The old variety testing plot was removed in the fall of 1951. From the 13 varieties on test only Viking and Newburg can be recommended and even these varieties suffer considerable winter injury, especially when grown in the north and eastern areas of Nova Scotia.

TABLE 17.—RED RASPBERRY YIELDS. FIVE-YEAR AVERAGE FROM OLD PLOTS
1947-51

Variety	Yield per acre	Season
	pints	
Newburg	3761	Midseason
Viking	3702	Early to midseason
Rideau	2586	Midseason
Washington	2341	Late
Taylor	1961	Late
Ottawa	1563	Midseason

The new plantation made in 1949 produced its first full crop in 1951. Additional varieties were added in 1951 so that there are now 19 varieties on test. In this new planting the varieties Newburg and Viking are again performing well with the variety Trent showing much promise as an early-fruiting, productive, winter-hardy sort.

Mulching Red Raspberries

The mulching experiment which was begun in 1945 was concluded in 1951. Nine plots, each 100 feet long and 30 feet wide, received the following random treatments: 3 plots clean cultivated, 3 plots mulched with five inches of softwood sawdust and 3 plots mulched with hay. During the experiment no additional sawdust was applied to the plots. However, additional hay was required. Fertilization was in the form of an annual spring application of 9-5-7 at the rate of 1000 pounds per acre.

TABLE 18.—EFFECT OF MULCH TREATMENTS ON YIELDS OF RED RASPBERRIES 1947-51

Plot	5-year average		pH* 1945	pH* 1950	Soil moisture,** July, 1950
	Yields	Index			
	pt.				%
Sawdust mulch	3608	100·0	5·17	5·83	16·0
Hay mulch	2662	73·8	.....	5·83	14·1
Clean cultivation	1951	54·1	5·57	5·91	10·8

* pH taken June 30, 1950, average of 0-6, 0-12, 12-18 inch depth.
** Per cent moisture based on top 6 inches of soil taken July 27, 1950.

This cultural experiment indicates the value of sawdust as a mulch for red raspberries. Sawdust aids greatly in the control of weeds and retains the moisture so necessary for maximum production. Winter injury did occur in the sawdust plots but was not so severe as in the hay plots. The same is true for the disease anthracnose. The clean cultivated plots were the least injured by winter and disease but they also produced the least number of canes. Varietal response to treatments was most marked in Newburg where it continuously produced the best under the high moisture provided by the sawdust mulched plots.

Currants and Gooseberries

The present plot of 28 varieties of currants and gooseberries was planted in the spring of 1949, and the first production is expected in 1952. On the basis of previous tests, the following varieties are recommended.

Red Currants: Red Lake, Red Cherry
Black Currants: *Consort
White Currants: White Grape
Gooseberries: Clark, Poorman, Silvia

*A new rust-resistant variety, for trial only.

Grapes

There are no commercial vineyards in Nova Scotia because as yet there is no worthwhile variety that will consistently mature its fruit early enough to escape the fall frosts.

Grape varieties (Figure 6) have been tested at this Station since 1913. The present planting consists of 27 different varieties. For home gardens and other especially suited areas the following varieties are recommended.

Blue-blacks: Fredonia, VanBuren, Athens

White: Portland, Ontario

Figure 6. The grape variety Portland growing in the vineyard at Kentville. While this area is marginal for grape production, this photograph shows that they can be grown quite successfully.

Hops

For several years at this Station mature bines of the variety Fuggles have been producing hops. Yields and harvest cost indicate that hops are not a profitable crop for Nova Scotia farmers to produce. For the past three years the Station planting has been producing about 2000 pounds of green hops per acre. It appears that the 100 acres that would have to be put to hops to produce Nova Scotia's needs could be more profitably utilized for other types of crop production.

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NATIVE FRUITS

E. L. Eaton

Blueberries

The highbush blueberry plantation with its heavy yields of large berries (Figure 7) continues to be an object of great interest to visitors at the Station.

The original block, set in 1926, seems to have reached the point where annual growth is about balanced by the old wood removed. This condition applies as truly to the comparatively small bushes of Sam and Greenfields as to the much higher Adams, Grover and Katharine, or the intermediate Harding and Pioneer.

It is now evident that the 1937 plantation, spaced with six feet between rows and plants four feet apart in the row, is too close for standard varieties. Limbs of Rancocas, Adams, Katharine and Rubel have filled the spaces so that it is difficult to carry trays or crates of fruit to the end of the rows at picking time. Spacing of eight by eight or ten by five feet is preferable if tractor or horse-drawn implements are used.

Figure 7. Highbush blueberries at Kentville. To those who have known only the lowbush type, these upright bushes with high yields of large berries offer exciting possibilities.

Blueberry Breeding

A large number of controlled crosses have fruited in the period covered by this report. Because of the size and colour of fruit, Kengrape has been used in many of the combinations. Some of the best progeny have now been moved from their original rows to a smaller testing ground. Cuttings are being rooted to give a larger number of plants for study. Among the promising highbush progeny are those resulting from the crosses Stanley ×

Rancocas, Stanley × Pioneer, Kengrape × Stanley, Maxwelton 2 × Wareham, Kengrape × Jersey, Stanley × Kengrape, Jersey × Kengrape, Stanley × Stanley, Kengrape × Wareham.

Crosses between a highbush variety and the native lowbush have all been intermediate in type, none possessing the suckering habit of the wild form and none being so tall as the highbush parent. Four of the best of these were pollinated with each other, the seed bulked and sown in greenhouse flats for an F_2 generation, some of which it is hoped may combine more of the desirable characteristics of the original parents.

Blueberry Propagation

A wide variation in the ease of rooting cuttings of the different varieties has been noted at Kentville and elsewhere. Kengrape and Pioneer, two varieties that have been somewhat difficult to root in the shaded-peat frames, rooted freely on the stems when mounded with peat or sawdust for two years. The branches were then severed, set in a permanent place and subsequent growth has been equal to the best two- or three-year-old plants grown in the usual way.

The cost of the shaded-sash frames and the necessary attention to ventilation have made blueberry plants rather costly. The peat cutting operations on the Caribou Bog at Aylesford by the Annapolis Valley Peat Moss Company, gave an opportunity to try the undisturbed peat as a rooting medium. In 1950, a few hundred Rancocas hardwood cuttings were set under a 50 per cent lattice shade, without glass (Figures 8, 9.) The cuttings were carefully watched throughout the season, but otherwise received no attention. Over 90 per cent took root.

Figure 8. Rooting highbush blueberry cuttings under lattice on undisturbed peat. By this simple method large numbers of plants may be produced at a low cost.

After this initial test the owners of the peat bog embarked on a commercial trial in 1951, following the same plan.

Whips were purchased from a recommended source in New Jersey, made into four-inch cuttings and set the week of April 15. Counts of survivors were made on August 1, and are given in Table 19, at which time the lattices were gradually removed.

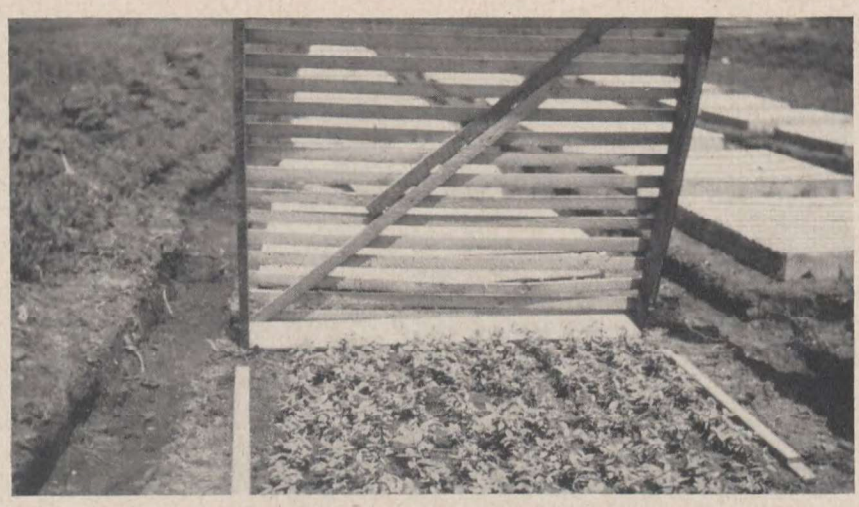

Figure 9. Rooting highbush blueberry cuttings under lattice on undisturbed peat. A cutting frame with the lattice raised to show the young plants. Note the uniformity of rooting and general vigour.

TABLE 19.—BLUEBERRY PROPAGATION IN UNDISTURBED PEAT, AYLESFORD, 1951.

Variety	Number of cuttings set	Number dead	Per cent dead
Rancocas	3848	27	0·7
Burlington	4141	44	1·0
Jersey	4132	116	2·8
Stanley	2220	75	3·5
Atlantic	2790	619	22·2
Totals	17131	881	5·1

Final counts of those transplanted to nursery rows in the spring of 1952 will doubtless reveal more losses; nevertheless the results in both 1950 and 1951 point the way to solving the major problem of the commercial grower, a source of inexpensive plants near at hand.

Tests at Outside Locations

Since the highbush blueberry is not found wild in Nova Scotia outside of Shelbourne, Yarmouth and Digby counties, doubt has existed just how far north or east it might be grown. To secure information on this important point, plantings of about one-quarter acre have been made at a number of places on private land. The plan has been a simple one, the Experimental Station furnishing the plants and supervision, the owner giving the land and labour, the public receiving the information and the grower retaining the crop. Since many of the plants available have been seedlings the plan has also afforded an opportunity to test these and possibly locate some that would be particularly suited to their more severe environment.

A block of around 200, set as tiny plants at Oxford, Nova Scotia, yielded over 1000 pints in 1950, and somewhat more in 1951. A smaller block just south of Grand Lake, New Brunswick, set in 1942, has Rancocas, Pioneer and cuttings from the old seedling block at Kentville. All are producing heavily and with little evidence of winter injury.

A number of other outside plots at Petitcodiac and at Becketville in New Brunswick, and Pugwash Junction, Scotsburn, Mill Village and Carleton in Nova Scotia, also prove that the crop may be grown rather widely.

Highbush Blueberry Culture

Damp soils, similar to those where the blueberry is native, are so subject to early spring freezing and thawing in our climate that plants have lifted out badly. On soils that are well drained and naturally fertile, the plants are thriving.

It was early found at Kentville that sawdust mulch applied over all the ground held the necessary moisture during midsummer and continued to be beneficial for many years even after being mixed with the soil. More recently, satisfactory growth has been secured where the sawdust was (*a*) applied annually in small quantities, (*b*) applied heavily and harrowed into the soil, or (*c*) applied heavily and ploughed under deeply. A test is now in progress to find if a deep, narrow trench filled with sawdust and covered with soil, directly under the row, may be equally suitable. The use of peat as a substitute is being compared with the sawdust, but the results are not yet available.

Cranberries

The seedlings and clonal selections made over a period of years from eighteen distinct sources of material in the Maritimes and assembled on a section of a commercial bog at Aylesford, have all fruited in sufficient volume to be evaluated. During the period under review notes have been made in the field, size counts taken of the fruit, and examinations made of the berries after being kept for several months in rather variable storage conditions.

All the selections are now being discarded except two whose performance has been consistent and outstanding for the past five years. One of these is early, the other late.

The early variety was secured at Beaver River, Digby County, Nova Scotia, on the property of Mr. Charles Wyman. Compared with the commercial variety Early Black it is ready for market at least a week sooner, and the fruit is larger and more nearly globular in shape. It has been one of the latest keepers and is highly attractive in appearance.

The late variety was secured in a wild bog on the property of the late J. H. G. Alcoe, Cumberland Point, New Brunswick. The fruit is somewhat elongate in shape but is otherwise symmetrical. Early in the season colour is lacking, but at full maturity it is well coloured. In the small clones it has been prolific, though the fruit is possibly too close to the ground for easy harvesting.

Plans are being made for a new series of larger plots to compare these two new varieties with the old New England standards, Howes and Early Black.

Elderberries

This fruit, offering so much flavour and eye appeal when blended with apple and served as juice, jelly or pie filler, has not yet been adopted by our commercial processors. Many requests are received at the Experimental Station for plants for the home garden and, in season, for the fruit.

Propagation

Elderberries root freely at each node when dormant cuttings are placed in damp sand or sawdust. They grow rapidly and fruit early, usually in two or three years.

Breeding

The Adams variety from Geneva, a large-fruited and vigorous sort, is a few days late to develop fully at Kentville in some seasons. Several hundred seedlings of this variety have been grown at Kentville, and four which produce large berries and are a week or so earlier than Adams, have been chosen for further testing.

Attempts have also been made to cross the purple species (*Sambucus canadensis* L.) with the earlier and inedible red-fruited species (*Sambucus pubens* Michx.). The wide difference in bloom dates offers a problem in bridging the gap, and the first lot of seedlings proved to be all of the purple species. Among the progeny of a second attempt, one plant is being jealously watched in the hope that it may prove to be the desired hybrid.

VEGETABLES

E. W. Chipman

During the period covered by this report, the principal work carried on with vegetables has been variety testing. Many new varieties and hybrids considered to be worthy of trial have been compared with the old standard types. Through these trials the most suitable varieties and hybrids have been selected and are recommended in this report. Cultural experiments have also been carried out to determine the methods to be employed to obtain maximum yields, and to aid the vegetable grower.

In 1947 a breeding project with tomatoes was begun in order to obtain more desirable varieties and hybrids for this region. Breeding work with peas and onions has also been carried on.

All vegetable trials have been carried out on a well drained sandy loam. Stable manure at rates of 10 to 15 tons per acre was applied annually, supplemented with a broadcast application of approximately 1500 pounds of 3-15-6 fertilizer mixture per acre. Where necessary, side applications of nitrates (ammonium nitrate, 200 pounds per acre) have been added.

The land was used continuously from year to year, following a system of rotation to avoid the planting of the same crop on a specific area in successive years.

Perennial Vegetables

Asparagus

In 1947 a cutting experiment with asparagus was started in order to determine the correct length of time to cut the tips. The object was to obtain maximum yields of high grade asparagus over a period of years.

Two varieties, Mary Washington and Donald Elmira Seedling, were used. The area was divided into five treatments of 5-week, 6-week, 7-week, 8-week and 9-week cuttings. Each treatment had four (2 per variety) randomized plots which were 16½ feet long.

All the tips were cut and weighed for the five years covered by this report. Records for the first year are not given, as it was believed that at least that period of time would be required before any effect could be observed. The four-year (1948-51) total treatment yields are presented in Table 20.

TABLE 20.—ASPARAGUS YIELDS AT DIFFERENT CUTTING PERIODS, 1948-1951

Cutting period	1948	1949	1950	1951	Totals
	oz.	oz.	oz.	oz.	oz.
5-week	152·5	129·0	239·0	188·0	708·5
6-week	199·5	201·5	302·5	252·5	956·0
7-week	217·0	222·5	294·0	267·0	1000·5
8-week	221·5	217·0	333·0	285·5	1057·0
9-week	194·0	177·0	268·5	177·5	817·0
Totals	984·5	947·0	1437·0	1170·5	4539·0

From the above table it will be noted that the 9-week cutting yielded considerably less than the previous treatment, clearly indicating that cuttings should not be carried beyond 8 weeks. Also it would appear that the increase in yields beyond 6-7 weeks, particularly during some seasons, may not be high enough to justify the cutting.

Yields from the Mary Washington plots were distinctly higher than the Donald Elmira Seedling.

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Rhubarb

Varieties of rhubarb have been tested with the object of finding a high quality type, of good appearance, suitable for this locality. Ruby, Valentine, Macdonald and Sunrise are all good red varieties suitable for this area.

Leafy Vegetables

Cabbage

Forty-one varieties and one hybrid were tested, from which the following are recommended:

Early—Green: Golden Acre, Copenhagen Market
Red: Red Acre
Savoy Green: Early Perfection

Midseason—Green: Bonanza

Late—Green: Danish Ballhead, Penn State Ballhead
Red: Mammoth Red Rock
Savoy Green: Chieftain Savoy

For Chinese cabbage, the variety Chihli is the most suitable. The seed of this vegetable should not be sown until the first week of July, otherwise the plant will bolt and form a seed stalk.

Cauliflower

Twenty-four varieties and strains were tested, from which the following are recommended:

Early—Primosnow, Snowball A

Main Crop—Perfected Snowball, Snowball Y

Other good late strains are Stokes Super Junior, Codania, Snowball M.

Brussel Sprouts

Of the six varieties tested the varieties Long Island Improved and Catskill are recommended.

Broccoli

In sprouting broccoli, the varieties De Cicco and Italian Green Sprouting are recommended.

In general, the season is too short in this area for the heading sorts, which require a warm open winter. However, the variety Purple Broccoli has been grown.

Kale

The variety Dwarf Green Curled is recommended.

Kohl Rabi

The varieties Purple Vienna and White Vienna are both suitable for this area.

Spinach

Sixteen varieties of spinach were tested and the following are recommended: Bloomsdale Longstanding, King of Denmark and Nobel.

Where a green is required during July and August, New Zealand spinach may be grown.

Swiss Chard

Four varieties of chard were tested. All have done well, with Lucullus being the most desirable.

Celery

Six varieties of celery were tested for quality and yield, and the following are recommended: Utah No. 15 (green) and Golden Self Blanching (golden).

Lettuce

Thirty-one varieties of lettuce have been tested, and the following are recommended:

Head Lettuce—Crisphead varieties: Premier, Pennlake, Progress
—Butterhead varieties: White Boston

Leaf Lettuce—Grand Rapids

Other suitable crisp head varieties are New York, Imperial No. 44, Imperial No. 756, and Cosberg.

Dates of Planting—Each year the varieties under test have been planted on different dates to determine the time to seed for a successful crop. Conclusions from these experiments are that the greenhouse crop should be sown around March 20 to be transplanted the first week in May. Outdoor seeding should be done early in May. Where irrigation is available, sowings as late as July 15 may be made.

Vine Crop Vegetables

Cucumbers

Nineteen varieties and five hybrid slicing cucumbers were tested. It was observed that the hybrids were heavier yielders than the varieties. However, where appearance was considered, some of the varieties were superior. The following are recommended: Marketer, Straight Eight, Burpees Hybrid, Sensation Hybrid and Cubit.

Thirteen varieties of pickling cucumbers were tested. Apart from whether they are white or black spined a great similarity exists between varieties, except for two, Rhensk Druv and Baldus Delikatesse, which are very heavily spined. On the basis of yield, the following are recommended: Snow's pickling, Producer and Rhensk Druv.

Figure 10. Fine specimens of Sugar Salmon muskmelon. This crop may be successfully grown at Kentville in many seasons.

Melons

Muskmelon—Fourteen varieties of muskmelon (Figure 10) were tested in an attempt to find a high quality, early, productive variety.

Farnorth is perhaps the earliest, but its quality is not high. Other suitable varieties are Sugar Salmon, Golden Champlain and Delicious.

Watermelon—Ten varieties and two hybrid watermelons were tested in an attempt to find an early high quality melon. The following were selected: Sweet Sensation, Honey Cream and New Hampshire Midget.

Citron

Red Seeded citron is a suitable variety.

Squash

Of the twenty varieties and two hybrids of squash tested for quality, marketable size, and yield, the following are recommended: Kitchenette, Buttercup, Improved Hubbard and Long Keeping Sweetmeat. Other good varieties are Golden Hubbard, Delicious and Uconn.

The variety Yankee Hybrid is an excellent summer-type squash.

Vegetable Marrow

One variety and one hybrid were tested for quality and yield, from which Hybrid Cocozelle was superior.

Corn Varieties

Eight pure varieties and sixty-eight hybrids of corn have been on test during the five-year period, 1947-51. Growing conditions, except for a drought period in 1949, were favourable. The following, listed in order of season from early to late, are the hybrids recommended for planting in the Annapolis Valley: Goldmine, Spancross, Golden Rocket, Seneca Golden and Seneca Chief.

Other hybrids worthy of mention in order of season: Seneca 60, J-6 Cross, Hybrid Golden Gem, Seneca Dawn, Sugar Prince, North Star, Marcross, Gold Rush, Hybrid Golden Bantam, F. M. Cross, and Big Mo.

Leguminous Vegetables

Bush Beans

Wax Podded—Of the fourteen tested, Puregold, Sensation Wax and Round Pod Kidney Wax are recommended.

Green Podded—Of the twenty-eight varieties tested, Supergreen, Logan Improved, Ranger and Contender were selected as the most suitable.

Other varieties worthy of mention are Rival, Topcrop, Longreen, Slendergreen and Idagreen.

Pole Beans

Of the six varieties tested Kentucky Wonder Wax and Blue Lake are recommended.

Broad Beans

The two varieties tested, Broad Windsor and Express have yielded excellent crops. In order to prevent damage from aphids, broad beans must be sprayed.

Lima Beans

Very unsatisfactory results have been obtained with these. Of the six varieties tested over the five years, Early Market has shown the most promise. This is a dwarf type which did produce a small crop. The seed of limas should not be planted before June 15.

Field Beans

Four strains, A, B, C and D were obtained from Ottawa for comparison in 1948 with the Kentville strain, Kenearly Yellow Eye. These were seeded in 50-foot rows, and replicated four times in randomized plots. The rows were 28 inches apart, and the plants were thinned to 50 plants per plot.

Although no significant difference in yields was obtained it was observed that Kenearly was ten to twenty days earlier than the other strains—which is an important factor for any marginal growing areas. Another factor in favour of Kenearly is its semi-dwarf habit with no runner growth. facilitating closer planting and less loss from pods getting down on the soil.

Variety Experiment

The following varieties have been on test for three years: Kenearly Yellow Eye, Soldier, Great Northern, Red Kidney, White Marrowfat, White Kidney, Mohawk, Jacob's Cattle and Norwegian. The seed was sown in 30-foot rows, and the plots randomized and replicated four times.

Where yields have been compared, Michelite and White Marrowfat have been significantly greater. In one year Great Northern was also high. In this area any beans with a longer growing season than 110 days will not mature satisfactorily every year.

Great Northern (a flattened white bean) was the highest-yielding early season variety. Other suitable varieties in order of season are Norwegian, Jacob's Cattle, Kenearly and Soldier. With these varieties no significant differences in yield existed.

Peas

For four years growing conditions were unfavourable with irregular moisture supply resulting in either a poor germination or reduced yields of the late-maturing varieties.

The diseases caused by *Fusarium, Oxysporum* and *Ascochyta pinodella* have caused some losses.

Sixty varieties of peas have been on trial, thirteen of them having been carried for four years. The following are the recommended varieties, listed in order of season from early to late: Fenland Wonder, Little Marvel, Director and Ottawa PE2.

Other varieties worthy of mention are Engress, Laxton's Progress, Laxall and Radium.

Root Vegetables

Carrots

Twenty-three varieties and strains of carrots have been on trial, five of which have been carried for five years as standards. The following are recommended on the basis of appearance, quality and yield: Imperator, McDonald's New Coreless and Amsterdam. Other varieties worthy of mention include Nantes and Morse's Bunching.

Beets

Twenty-nine varieties and strains of beets have been on trial, of which three strains of Detroit Dark Red have been carried for five years as standards. The following are recommended on appearance, quality and yield: Ferguson's Improved Dark Red, Detroit Dark Red No. 16 and Perfected Detroit. Other varieties worthy of mention are New Early and Rennie's XXX Table.

Parsnips

Of the eleven varieties and strains of parsnips tested, Hollow Crown and New No. 10 are recommended. Other good varieties are Harris Model and Guernsey.

Radish

Of the twenty varieties tested, Comet, Cherry Belle and Lone Star are considered the most suitable.

Onions

In the five-year period covered by this report, the following samples of onions have been tested: Yellow, twenty-three varieties and ten hybrids; White (pickling types), six varieties and one hybrid; Red, five varieties.

Since 1949 it has become increasingly evident that the F_1 (first) generation hybrids will outyield and are generally more adaptable to this area than the standard varieties. By the use of these hybrids the growing time is so shortened that onions can now be raised in many new areas. The hybrid seed is still quite expensive.

The following are recommended for outdoor seeding: *Yellow:* Kenearly, Early Yellow Globe, Mountain Danvers, Burpee's Yellow Globe hybrid, Asgrow Y40; *Red*: Red Wethersfield, Red Globe; *White Pickling*: White Barletta, White Portugal.

Solanaceous Vegetables

Tomatoes

Ninety-three varieties and F_2 (second generation) hybrids and eighteen F_1 (first generation) hybrids were tested. In addition to determining their adaptability to this area an effort has been made to select suitable material for a tomato breeding project.

Since 1947 it has become increasingly evident that the F_1 hybrid tomatoes will outyield standard varieties and are generally more adaptable to this area. In fact, in 1950 and 1951 three-quarters of the top yielders were F_1 hybrids.

The following varieties and F_1 hybrids, arranged in order of season, except that the hybrids are all early, are considered the most suitable for this area: Meteor, Quebec No. 5, Gem, Earliest and Best, Urbana, Morden Hybrid No. 2, Monarch Hybrid, Burpee Hybrid, Early Hybrid. Other promising F_1 hybrids are Mustang, Fordhook hybrid, Minnyhybrid, D003 and Vaughan's Early Hybrid.

Peppers

Green sweet and hot peppers can be grown without any difficulty, and during favourable seasons (frost-free falls) many will ripen or turn red. To prevent damage to the blossoms by tarnished plant bug, which affects the set of fruit, the plants should be sprayed or dusted with DDT.

Of twenty-two varieties of sweet peppers and four of hot peppers tested, Earliest Red Sweet, Penn Wonder (sweet) and Long Thick Red (hot) are recommended.

Egg Plant

One variety, Black Beauty, is suggested for planting in the Annapolis Valley area.

Tomato-breeding Project

A tomato-breeding project was begun in the winter of 1949 for the purpose of obtaining an early high-yielding variety, a main-crop high-yielding variety and a tomato with resistance to late blight.

Of the F_1 hybrids obtained a number seem to be quite promising. From one, Early Chatham $\times$ Bounty, selections have been carried forward to the F_3 generation, giving what appears to be an outstanding first-early type.

Lycopersicon esculentum var *cerasiforme*, a small-fruited tomato from Guatemala, C.A., is being grown and tested for resistance to late blight, with the object of using it as a source of this factor in crosses with commercial types.

Male sterile lines discovered locally are being studied with the object of producing cheap hybrid seed. An attempt is also being made to transfer the gene for sterility to varieties which have already produced valuable hybrids.

Tomato: Hormone Experiment

Hormones have been used at this Station on tomato plants to induce parthenocarpic (seedless) fruit by spraying the flowers with the hormones, and to determine if spraying with hormones will increase the yields and size of early fruit.

In 1947 some plants were sprayed from one to four times, and the flowers on other plants from one to three times with the following chemicals: p-naphthoxyacetic acid in a concentration of 20 parts per million for the plant and 75 parts per million for the flower; "No Seed", a commercial preparation containing p-naphthoxyacetic acid in such concentrations that the final dilution was from 50 to 75 parts per million, plus other chemicals for increasing the solubility. With each treatment control plots were run. All fruit was picked, counted, weighed and cut. No significant differences were apparent in the yields, but 23 per cent of the fruit was seedless.

In 1950 the flowers were sprayed four times at seven-day intervals with "Sure-Set" (a commercial preparation, the basic ingredient of which is p-chlorophenoxyacetic acid) at a concentration recommended by the manufacturers. Early yields were increased 60 per cent, but some of the fruit was deformed and seedless.

In 1951 the same chemical ("Sure-Set") and procedure were used as in 1950. There were no significant differences in yield.

It would appear that the use of hormones is justified in years when the weather is such as to impair natural pollination of the first few blossom clusters.

Tomato: Fertilizer Experiment

To determine the correct time to apply fertilizers to tomatoes for producing early and maximum yields of fruit, an experiment was begun in 1947 in which two plants were set for each treatment. The area fertilized was a six-foot square around each plant, or 72 square feet for each two plants under treatment. The distance between treatments was six feet; the plots were randomized and replicated three times.

The fertilizer (3-15-6) was applied at the rate of 1000 pounds per acre. The time and rates of application were as follows: (A) applied at time of setting the plants; (B) applied 20 days after setting; (C) applied 40 days after setting. The treatments were: A, B, C, AB, BC, AC and ABC (in these latter cases part of the 1,000 pounds general application was applied at the different times).

In 1947 no significant differences in yields were obtained. In 1948 treatment A gave a significantly higher yield of ripe fruit and total fruit over the other plots, which did not differ.

On the basis of the results obtained it would appear that season (rainfall and temperature) are more important factors than the actual time of application of the fertilizer.

FRUIT AND VEGETABLE PROCESSING

G. W. Hope

Preparation of Apple Syrup

Numerous attempts have been made to prepare sweet or bland syrups from apple juice by techniques which have relied upon the neutralization of the acid of the apple before concentration of the juice. These have resulted in syrups not suitable for food because of the retention by the syrup of unpleasant tastes, and because of the danger of poisons from spray residues. In recent years a new chemical technique known as "ion-exchange" has been used successfully in the treatment of other sugar-bearing solutions and attempts have been made, with some measure of success, to apply this technique to apple juice.

Synthetic resins have been developed which, when placed in solutions form a dissociated or active basic ion and an insoluble residue. These are mostly, if not all, amine derivatives capable of exchanging hydroxyl (OH^-) groups for other anions. Cation exchangers contain an insoluble portion and reactive acidic groups, such as sulphonic (SO_2OH) phenolic (OH) or carboxylic (COOH). which can react with metallic salts in the solution. Thus, theoretically, it should be possible by proper manipulation, to remove all the acid and all the metallic salts from apple juice leaving only the undissociated solids, such as sugar, in solution.

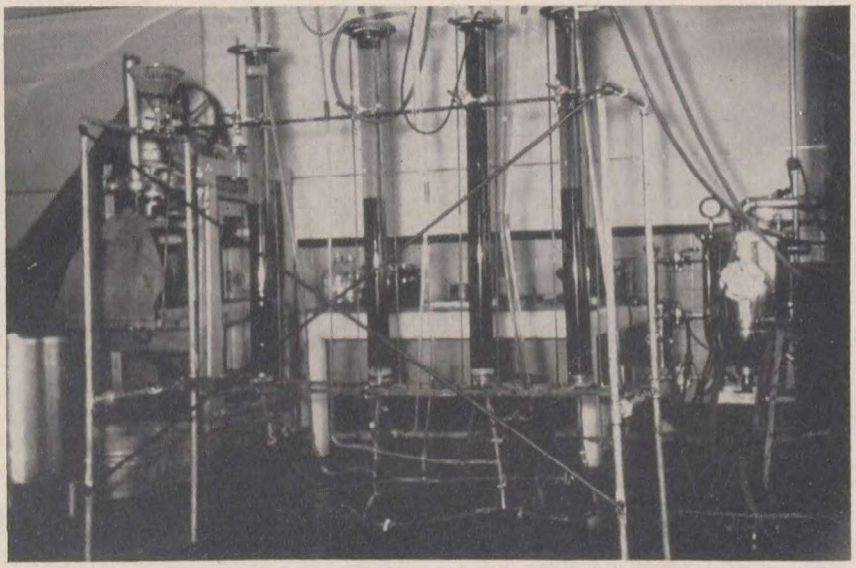


Figure 11. Ion exchange glass column assembly for the production of apple syrup. In the right background is the low pressure evaporator for concentrating the juice.

It was found possible to prepare an apple syrup suitable for use as a table syrup by the following procedure. Resin beds two feet deep were made up in glass columns (Figure 11). Apple juice was depectinized, filtered and run through the exchanger beds in the sequence anion-cation-anion-cation.

Changes in aeidity and conduetivity were followed and, when the beds approached saturation, the flow was stopped and the juiee boiled down under vaeuum. The beds of resin were then rinsed with water and treated with solutions of reagents (5% sulphuric acid for cation and 4% sodium hydroxide for the anion beds) to regenerate the resin and prepare it for a fresh run of apple juice.

It was found that a single anion bed would remove the natural aeid of the juice, but the eolour was unattractively dark and the flavour disagreeable. A single anion followed by a single cation bed gave a juice which was too acid. A single cation followed by a single anion was not practical beeause of overloading of the anion exchanger bed by the natural aeid of the juice plus the acid formed in the exchange of cations in the first column. Further, neither single nor two-column systems could be relied upon to remove lead or arsenic spray residues. A three-column system anion-cation-anion removed practically all the arsenie and lead, but gave a dark syrup of unattractive colour and taste. The eolour of the finished syrup was lightened to an attraetive orange red by the addition of a fourth cation exchange column.

Syrup made from this latter "4 stage" juice is of good flavour and appearance. It contains less than 0.05 per cent malic acid, has a pH of about 3.6, and a eonductivity of less than 20 x 10^{-5} ohms. The apple flavour is, of course, lost in concentration unless temperatures are kept low or the volatiles are trapped and returned to the concentrate.

Canning—Variety Trials

Plums—Considerable work is being done at the Kentville Station in conneetion with the testing of plum varieties. Twenty-one varieties were eanned during the 1946-47 season and were scored on the basis of appearanee and flavour. Those showing most promise were Clymen, Hall and de Montford.

Strawberries—Eleven varieties of strawberries were eanned and examined six months later by a taste panel. Valentine, Fairland, and Temple were the most outstanding. Catskill was found to be unsatisfactory.

Raspberries—Of ten varieties of red raspberries, Willamette, Cuthbert, Rideau and Munroe were found to give the best canned product. Grading was done by a taste panel on the basis of appearanee and flavour.

Beans—Fifteen of the newer varieties of green snap beans were compared on the basis of appearance and flavour. Differences were slight but some preference was shown for Fullgreen, Idagreen and Wade 1515. Of the wax beans tested, Sensation, Pure Gold, Kinghorn and Round Pod Kidney Wax were the best.

Pears—Of twenty-five pear varieties eompared on basis of eolour, flavour and texture of the eanned product, the following were found acceptable (the date fruit was eanned is given in brackets): Clapp Favorite (Sept. 17), Bartlett (Oct. 1), Cayuga (Nov. 1), Bosc (Nov. 8), Dumont (Nov. 14), Willard (Nov. 27). Flemish Beauty (Oct. 15) was degraded on flavour, but the fruit used had been harvested before eorrect maturity was reached. Under more favourable harvesting eonditions this pear would also have been found acceptable.

Freezing—Variety Trials

Beans—Green and wax beans were trimmed, snipped, washed in cold water, blanched two minutes in boiling water, cooled and frozen in 2 per

cent brine. On thawing and cooking, considerable loss of colour occurred. Flavour was good, but inferior to the canned product. Pencil Pod Black Wax and Supergreen gave the most acceptable product.

Cauliflower—A blanch (in water) of 3 to 4 minutes was found to be more suitable for cauliflower of the Snowball type than shorter or longer blanch times. Snowball and Erfurt were the best of the varieties tested. Cauliflower frozen dry was found equally as good as that frozen in 2 per cent brine. Boiling thawed cauliflower for more than two minutes impaired flavour, texture and appearance.

Peas—Peas blanched three, two or one minute in boiling water and packed dry or in 2 per cent brine were equally acceptable when examined six to eight months later. Little Marvel, Freezonia, Thomas Laxton, Fenland Wonder and Alderman were the best of the varieties tested.

Rhubarb—Rhubarb of the varieties Ruby, Sunrise and Macdonald were cut in 1-inch lengths and (1) cooked in 60 per cent syrup (2) blanched 1½ minutes and packed in 45 per cent syrup (3) blanched 1½ minutes and packed with dry sugar in the proportion 4 pounds fruit to 1 pound sugar (4) packed unblanched in 45 per cent syrup and (5) packed with no treatment previous to freezing. All lots were frozen at −10°F. and stored at 0°F. The flavour and appearance of all lots was acceptable on thawing and cooking. Sunrise presented a better appearance than the other varieties.

Broccoli—Italian Green Sprouting, both 2N and 4N strains, were frozen following a four minute blanch, and were found to give an attractive product when subsequently thawed and cooked. The 4N strain was superior in flavour and texture of the stems. The 2 per cent brine pack was superior in flavour and appearance.

Spinach—Bloomsdale Long Standing and King of Denmark both freeze satisfactorily.

Corn—Vine-cross, Seneca 60, Dorinney and Spancross were found suitable for freezing on the cob. A blanch of 5 to 6 minutes at 210°-212°F. was found to give the best results. Maturity of the corn was found to be an important factor—fully mature cobs giving the best finished product.

Strawberries—Temple, Fairfax and Catskill were found best of the sixteen varieties tested. The dry-sugar—whole-berry pack was found equally as good as the sugar-syrup—whole-berry and dry-sugar—sliced-berry packs. All three were superior to the sugar-syrup—sliced-berry pack. Strawberries frozen without sugar quickly lost their flavour in freezing storage but remained acceptable up to December.

Raspberries—Taylor, Washington, Rideau, Viking and Newburg were found satisfactory. A preference was shown for berries packed in 50 per cent sucrose syrup. Unsugared berries were very poor.

COLD STORAGE AND PLANT NUTRITION

C. A. Eaves

Maturity of Apples in Relation to Keeping Quality

Experimental work prior to the last war showed conclusively that the storage quality of fruit was largely governed by the degree of maturity at the time of picking. For example, it was found that shrinkage, scald, core browning and pitted apples were associated with immaturity as measured by the starch-iodine test. Broadly speaking these functional disturbances occurred if apples were picked before the starch had disappeared from the core area.

Because of the risk of high winds and the tendency for McIntosh apples to drop prematurely, growers frequently harvest this variety too early. In order to discourage this practice, the Nova Scotia Apple Marketing Board co-operated with this Station in the distribution of iodine to growers, together with an illustrated concise instruction pamphlet. This was designed to delay the picking of McIntosh apples until they were at the right stage of maturity. No factual information could be obtained as to the results of this work, but it is believed that it, together with the radio bulletins, served toward achieving the objective.

With regard to the later varieties, harvesting must largely be governed by the size of crop and numbers of pickers available with a view to completing the operation before the first severe frost which may occur on or about October 20.

Investigations into the Bruising of McIntosh Apples

The McIntosh apple is a relatively soft variety and when making apple purchases the consumer has been found, through investigations in New York State, to be quite sensitive to the amount of bruising on the fruit.

A series of observations on bruising from the orchard to the packed box in storage were undertaken in 1949. Four orchards were used for this purpose, two of which were situated on a paved route to the storage and the other two on gravel roads. Another three orchards were similarly selected close by another cold storage plant. The fruit from each orchard was examined for bruising at five different stages as follows:

1. In the orchard, ten boxes examined.
2. Off truck at storage, five boxes examined.
3. After dumping on grader, three boxes examined.
4. Graded and wrapped in box or crate, nine boxes examined.
5. After closing box or crate, nine boxes examined.

TABLE 21.—PERCENTAGE OF BRUISING ON McINTOSH APPLES IN VARIOUS ORCHARDS 1949

Orchard number	Total bruises	Type of pickers	Container	Size and condition of fruit	Type of supervision
	%				
1	15·9	Father, son and regular helper	Basket	Medium small, hard	Good
2	33·3	Casual labour	Bags, false bottom	Medium large, soft	Poor
3	28·1	Casual labour	Bags, false bottom	Small, green, soft	Poor
4	15·7	Mixed labour	Bags, false bottom	Large, soft	Very good
5	26·2	Contract piece work	Canvas bags with hook	Medium large, soft	Good
6	46·0	Casual labour	Baskets	Small, soft, green	Poor
7	20·5	Casual labour	Baskets	Medium, hard	Poor

Bruises were classified as slight and soft, and records were taken on the top and bottom of boxes after picking and when unloaded at the cold storage plant. In order to ensure that there would be enough boxes of similar grades, 200 were taken from each orchard and those examined were picked at random. There was a wide variation in damage by pickers, but when averaged the bruise count for a particular orchard was quite constant.

In the above table, Orchard No. 4 illustrates very clearly what can be done by careful supervision. No differences could be found between paved and gravel roads, but it was noted that the rough approaches to one storage resulted in a relatively higher degree of bruising.

A separate test involving the use of three picking containers, namely canvas bags and canvas-lined baskets both with false bottoms and baskets, indicated less bruising occurred with canvas-lined baskets.

TABLE 22.—PERCENTAGE OF BRUISING ON McINTOSH APPLES AT VARIOUS HANDLING STAGES 1949

Position	In orchard	Off truck at storage	After* grading		After* wrapping		After* closing box	
	Slight	Slight	Slight	Soft	Slight	Soft	Slight	Soft
Top of box	18·7	35·1	37·0	2·5	47·6	1·8	54·5	6·0
Bottom of box	22·4	43·1	.....	.....	.....	.....	.....	.....

* Entire box sampled.

These figures are in a sense cumulative in that the boxes examined when packed were from the same lot examined in the orchard. Observations also clearly showed that there was considerably more bruising in the crate (jumble pack) than in the packed box, tight facing increased soft bruising and that there was least bruising among the small sized apples.

The following recommendations were made:

1. Corrugated pads in picking boxes.
2. Canvas-lined picking basket with false bottom.
3. Close supervision of pickers.
4. Improved approaches to storages.
5. Prevention of overcrowding on grading machines.
6. Supervision to prevent excess bruising by packing too tightly.
7. Greater care in handling C grades on the grader.
8. Elimination of bruises at the top of the box when lids are pressed and nailed into position.
9. Daily written record of "goodness of pack" for individual packers.
10. Increased supervision at all stages of handling.

Influence of Apple Tree Nutrition upon the Keeping Quality of Fruit

These studies may be divided under the following headings.

a. Orchard fertilizer trials

b. Commercial orchard survey

c. Nutrient sprays on apple trees

The major project in connection with the influence of fertilizer is located at Nictaux, Nova Scotia. This orchard consists of a solid block of Cortland trees approximately twenty years old, and now in sod strip. There are four main blocks receiving basic treatments designed to evaluate the influence of dolomitic limestone and superphosphate. Superimposed across these blocks are fifteen annual treatments consisting of varying amounts of nitrogen, superphosphate and potash. Each of the sixty plots contains three trees and is surrounded by guard trees.

One-bushel samples of fruit were removed from each plot and placed in storage at 34°F. Table 23 indicates the quality factors which were studied.

TABLE 23.—INFLUENCE OF DOLOMITIC LIMESTONE AND SUPERPHOSPHATE ON THE QUALITY OF CORTLAND APPLES AT HARVEST 1949

Quality factor (average)	Control	4 tons lime	4 tons lime, 1 ton superphosphate	1 ton superphosphate
Maturity (starch-iodine)[1]	3·16	2·76	2·56	3·20
Size[2]	1·93	2·27	2·33	2·20
Colour (per cent blush)	64·70	52·70	60·00	65·00
Hardness (pounds pressure)	14·70	14·70	14·40	14·40
Acidity[3]	11·70	11·10	10·60	10·60

[1] Maturity (Starch-iodine)—Readings 1-2 indicate starch present in core area. Readings 3-4 indicate starch disappeared from core area.
[2] Size—1 indicates apples under 2¾ inches
3 indicates apples over 2¾ inches
[3] Indicated as the c.c's of 0·1N Ba $(OH)_2$ required to neutralize the juice.

From the foregoing table it will be seen that lime applications are associated with delayed maturity, increase in size and decrease in colour of the fruit. Hardness of the fruit does not appear to be influenced by these basic treatments, but acidity of the juice from the superphosphate treated trees is relatively low. This may be attributed, however, to the low level of magnesium in these trees.

TABLE 24.—INFLUENCE OF NITROGEN ON THE QUALITY OF CORTLAND APPLES 1949

Treatment	Number of plots	Maturity[1]	Size[2]	Per cent colour	Hardness (lb. pressure)	Acidity[3]
Nitrogen lacking	20	3·3	2·1	82·0	15·3	11·6
3N	12	2·9	2·1	62·3	14·5	11·2
9N	12	2·6	2·1	41·3	14·0	10·3
16N	12	2·7	2·4	43·6	13·9	10·3
N+ minerals	24	2·9	3·0	50·5	14·3	10·8

[1] Maturity (Starch-iodine)—Readings 1-2 indicate starch present in core area. Readings 3-4 indicate starch disappeared from core area.
[2] Size—1 indicates apples under 2¾ inches
3 indicates apples over 2¾ inches
[3] Indicated as the c.c's of 0·1N Ba$(OH)_2$ required to neutralize the juice.

Reference to Table 24 shows that the influence of nitrogen resembles that of dolomitic limestone in respect to delayed maturity, increased size and poorer colour, but that the addition of the mineral elements phosphorus and potassium offset these effects to some extent.

From the yield data dealt with elsewhere in this report, it will be seen that the three per cent nitrogen level with lime resulted in relatively high yields.

The quality of the fruit at harvest from trees so treated is relatively high, and is further improved by the use of superphosphate and potassium. Such high quality is a definite requirement for fruit which must be stored before marketing

The Cortland apple can be generally considered as a good keeper. It was found however, that after a period of storage, there were differences in quality brought about by orchard treatment.

Softening of the fruit and acid-loss in storage did not appear to be influenced by the basic lime and superphosphate treatments. Annual treatments of nitrogen, as shown in Table 25, resulted in a relatively low rate of softening, so that after five and a half months the fruit from all treatments showed much the same degree of firmness.

TABLE 25.—INFLUENCE OF NITROGEN ON THE RATE OF SOFTENING AND ACID LOSS OF CORTLAND APPLES STORED AT 34°F. AND HELD FOR ONE WEEK AT 65°F. 1949

Treatment	Hardness at harvest (pounds pressure)	Hardness after 22 weeks (pounds pressure)	Per cent softening	Acidity[1] at harvest	Acid[1] content after 22 wks.	Per cent acid loss
Nitrogen lacking	15·3	10·5	31·3	11·6	5·9	49·1
3N	14·5	10·3	29·0	11·2	5·3	52·6
9N	14·0	10·2	27·1	10·3	5·1	50·5
16N	13·9	10·0	28·0	10·3	5·2	49·5
N only	13·9	10·3	26·0	10·3	4·8	53·4

[1] Indicated as the c.c. of 1N $Ba(OH)_2$ required to neutralize the juice.

Rotting of the fruit in storage has been consistently greater in those samples picked from nitrogen-treated trees, whereas apples from untreated trees have invariably shown the highest percentage of scald. The scald appears as a superficial browning of the skin and is usually confined to the highly coloured fruits on the blush side. Table 26 illustrates the influence of tree nutrition and scald development.

TABLE 26.—SPOILAGE OF CORTLAND APPLES STORED AT 34°F. 1948

Treatment	Per cent rots	Per cent scald
N lacking	12·0	18·5
N only	21·8	4·0
3N	20·5	8·0
9N	23·6	3·3
16N	27·0	3·8
N + minerals	25·3	6·7

To sum up: delayed maturity, increase in fruit size and decrease in colour appear to be associated with applications of both lime and nitrogen. Reduced firmness and rotting were associated with the nitrogen treatments. Nevertheless, in storage the same fruit did not soften so rapidly as the controls.

Leaf Tissue Analysis

In addition to observations made on the keeping quality of Cortland apples the nutritional status of the trees was studied by means of leaf analysis.

TABLE 27.—LEAF TISSUE ANALYSIS OF CORTLAND APPLES (PER CENT DRY MATTER) 1950

Block Treatment	N	P	K	Ca	Mg
A Untreated	2·14	0·16	1·81	1·41	0·20
B Lime	2·10	0·15	1·34	1·38	0·26
C Lime and superphosphate	1·81	0·15	1·26	1·43	0·26
D Superphosphate	2·01	0·16	1·48	1·44	0·21
Plot					
1 0-0-0	1·90	0·16	1·20	1·47	0·25
2 0-10-0	1·76	0·20	1·20	1·53	0·23
3 0-0-5	1·84	0·16	1·50	1·41	0·22
5 9-0-0	2·23	0·13	1·10	1·41	0·26

The above table shows a striking decrease in leaf potassium and increase in magnesium content in the foliage from the trees treated with dolomitic limestone. With regard to the plot treatments it should be pointed out that the addition of the fertilizer elements is clearly reflected in the results obtained by tissue analyses and that nitrogen appears to have a depressing effect upon the uptake of phosphorus and potassium. This can be correlated with the quality of the fruit and is more direct and reliable than associating quality with treatment.

The Effect of Fertilizer Applications on Fruit Quality and Storage

Samples of fruit for storage tests and leaves for analyses were removed from a block of Wagener trees which had been treated with two levels of 9-5-7 fertilizer during the past twelve years. The results are shown in Table 28.

TABLE 28.—INFLUENCE OF VARIOUS RATES OF 9-5-7 FERTILIZER ON QUALITY OF WAGENER APPLES STORED AT 32°F. AVERAGE 1950-51

Treatment	Per cent dry matter of leaves		Per cent red colour	Per cent scald
	N	P		
Control	1·71	0·188	50·0	83·5
800 lb./A	2·05	0·164	35·0	91·5
1600 lb./A	2·15	0·155	35·0	100·0 (very severe)

With the Wagener variety scald is the main problem in storage and the above table shows that the highest rate of 9-5-7 results in poorly coloured fruit and a high incidence of scald. The leaf nitrogen definitely reflects the treatments received, but it is interesting to note that despite the increased applications of phosphorus in the fertilizer mixture this element shows a decrease. This negative relationship between nitrogen and phosphorus is also evident in the Cortland experiment and illustrates how a balanced or complete fertilizer if applied in excessive amounts can produce an unbalanced nutritional condition within the tree.

Survey of the Keeping Qualities of McIntosh and Northern Spy Apples from a Number of Commercial Orchards

This long-term project is designed to correlate those environmental factors which are mainly responsible for the quality of fruit. These include the nutritional status of the soil, organic-matter content and level of acidity. Greenhouse trials have been undertaken to test the ability of these orchard soils to support grass with the addition of varying amounts of lime and superphosphate. Analysis of foliage has been undertaken in order to find out what nitrogen and mineral levels are associated with the highest fruit quality.

The results of the soil and leaf analysis indicate that most orchards are well supplied with potash but are low in magnesium. Deficiency symptoms characteristic of a lack of magnesium are quite common in the area with many crops, and are particularly noticeable if there is heavy precipitation during May and June. This lack of magnesium leads to the development of small, highly coloured apples which mature early, and may cause losses from premature dropping. Analyses have shown that this deficiency is associated with a magnesium content in the leaf of about 0·175 per cent or less.

With both McIntosh and Northern Spy varieties, leaf nitrogen below 2·1 per cent is associated with good quality fruit. Furthermore, it has been found that the two orchards which produced the best fruit are characterized by soils with a low acid level pH 4·0-4·5 and only a moderate organic-matter content of approximately 5 per cent.

Nutrient Sprays on Apple Trees

In order to ascertain the influence of nitrogen sprays on the keeping quality of apples, percentage of blossom set, and the nitrogen content of the foliage, two series of three urea sprays (5 pounds per 100 gallons), one beginning at the calyx stage and the other seven days later, were applied to McIntosh, Delicious and Wagener trees. The results with the three early sprays (applied two days apart) are shown in Table 29.

TABLE 29.—INFLUENCE OF UREA SPRAYS (FIVE POUNDS PER 100 GALLONS) ON THE NITROGEN CONTENT OF APPLE LEAVES AND SET OF FRUIT (AVERAGE OF THREE TREES PER VARIETY) 1950

Variety	Per cent total N		Per cent set	
	Unsprayed	Sprayed	Unsprayed	Sprayed
McIntosh	1·93	2·09	11·4	13·2
Wagener	2·22	2·31	4·6	11·4
Delicious	1·95	2·22	14·1	19·6

It will be seen that there is a consistent increase in leaf nitrogen and percentage set. It was also noted that fruit from trees sprayed in the calyx stage showed no ill effects in regard to keeping quality. Nevertheless, the McIntosh apples sprayed seven days later than the calyx (three sprays at weekly intervals) showed a striking contrast to the untreated apples after three months in storage. They had both a very dull appearance and were severely affected with core flush.

Work with minor element sprays indicated that McIntosh apples sprayed with cobalt developed more colour and kept longer in storage. However, with the concentrations used in certain years the fruit became russetted, and foliage was injured. Further work is therefore in progress.

Gas Storage Trials

Investigations during the past three years have largely been devoted to semi-commercial trials with and without refrigeration and it is clear that McIntosh and Northern Spy apples are eminently suited to this storage method. In 1950 McIntosh were marketed locally in very good condition during the first two weeks in May after being stored in 7 per cent carbon dioxide at 38°F.

Red Spy and Northern Spy apples were successfully marketed during the same period from two cellar gas storages, one located at the Station and the other at Berwick, Nova Scotia. None of these apples were wrapped except for a few boxes in each store and it was found that the wrapped fruits, and to a lesser extent, those packed in shredded paper were severely damaged by a type of superficial scald. A concentration of 6 per cent carbon dioxide was used in these tests, and the temperature averaged between 40°-45°F.

The use of high concentrations of carbon dioxide during the first two weeks of storage in conjunction with cellar storage offers possibilities with winter varieties such as Northern Spy. Concentrations of carbon dioxide ranging between 15 and 34 per cent have been tried and it was found that 15-20 per cent was very effective in that the fruit remained hard and crisp until the middle of June.

Russet apples removed in February were very firm but slightly mealy whilst the variety Gano remained in very good condition.

With regard to the suitability of the gas storage method for apple varieties the following recommendations and observations are made:

McIntosh—Definitely benefited by 7 per cent carbon dioxide at 39°F. and will keep in good condition until the end of May.

Northern Spy—Similar to McIntosh except the storage temperature should be 32°F.

Ribston—Similar to McIntosh but should not be kept after middle of January.

Delicious—Requires low concentrations of oxygen (5 per cent) and carbon dioxide (2½ per cent) at 32°F. This involves the mechanical removal of carbon dioxide and is more expensive both in equipment and operation than in the case of McIntosh storage.

Golden Russet—Mealiness found to be developed in 1951 with 7 per cent carbon dioxide, further work is in progress.

Wagener—This variety which is highly susceptible to scald has responded surprisingly well to date to 7 per cent carbon dioxide. Further work is in progress.

Rome Beauty and Cortland have not responded to the gas mixtures tried, and development of scald after removal from storage is quite severe.

Investigations into the value of various construction materials used in the building of gas storages have shown that aluminum or galvanized iron sheeting and grey caulking compound are most satisfactory for the prevention of gas leaks.

Through the courtesy of a grower four storage chambers each with a capacity of 250 bushels were built in a warehouse cellar in 1950, in order to investigate the value of air cooled gas storage using Delicious, Ribston, Russet and Gano apples in 7 per cent carbon dioxide. The stores were constructed with aluminum sheeting and sealed at the joints with grey caulking compound. Satisfactory gas tightness was achieved.

One of the stores, filled with Delicious apples, was equipped with a sloping roof in order that cooling water from an adjacent well could be sprayed on the surface. As a further aid to cooling, an automatic differential thermostat

was designed and installed to ventilate the cellar when the temperature was higher than that prevailing outside. In this connection it was found that, during the latter part of October, the water-cooled store was maintained at 42°-44°F. in contrast to 48°-50°F. in the remaining stores.

The outside temperatures during November and December were 5° and 8° higher respectively than the monthly means averaged over a period of 33 years, and because of these conditions the results of the trials were rather disappointing, briefly these were as follows:

Delicious apples were found to remain very firm but were removed on January 15, 1951, because the flesh had became mealy in texture. These results are in keeping with those of other investigations, and it appears from later work at this Station that a low oxygen rather than increased carbon dioxide concentration is necessary for this variety.

Ribston apples were removed at the same time as the Delicious, and they were firm and crisp with a slight tendency toward mealiness.

However, in view of the shortage of metal for construction, tests were made of various plastics and paints which could be used to cover existing walls. A plastic known as "Cocoon" and black mastic have been found to be impermeable to carbon dioxide and can be applied to walls by means of pressure spray guns.

In conclusion, it has been consistently observed that fruit held in modified atmospheres remains in good condition longer than similar fruit from ordinary storage. Furthermore, the general belief that it is necessary to dispose of fruit after removal from gas storage does not hold, provided the temperature is held at 40°F. or below. This in turn makes it possible to successfully operate rooms with a considerable capacity, e.g., 15,000 bushels.

Investigations toward developing the most economical methods of storing apples consistent with good quality will be continued. New refrigeration equipment is now being installed at the Station and is designed to cope with any foreseeable problems of the future connected with fruit and vegetable storage.

Plant Nutrition Studies

During the past ten years great emphasis has been placed upon the nutritional status of crop plants in relation to production, largely as a result of the development of rapid methods for plant and soil analyses. By this means, mineral deficiencies in plants may be quickly diagnosed and corrective measures taken before crop yields are seriously affected. Furthermore, fertilizer requirements may be more accurately estimated if the nutrient uptake of a specific crop and the potential available soil nutrients are determined.

Commencing in 1948, preliminary studies were undertaken. The objectives were twofold, first to obtain a basic knowledge of the nutrient status of horticultural plants commercially grown in the area, and second, to make an intensive study of apple and pear tree nutrition in relation to fruit quality. The latter investigations have for the most part been reported in the previous section on storage investigations.

Small Fruits

Mulching experiments have been in progress for several years at Kentville with both raspberries and strawberries, and advantage was taken of these trials in order to study the plants and to find out the influence of various mulches on nutrient uptake. One variety of each plant was used, and leaf samples removed on two dates from duplicate treatments. The results of the analyses are shown in Table 30.

TABLE 30.—INFLUENCE OF MULCH UPON NUTRIENT LEVELS[1] OF RASPBERRIES AND STRAWBERRIES (R—VIKING RASPBERRIES; S—CATSKILL STRAWBERRIES), EXPRESSED AT P.P.M. SOLUBLES 1951

Treatment	Nitrogen[2]		Phosphorus		Potassium		Calcium		Magnesium	
	R	S	R	S	R	S	R	S	R	S
No mulch*	747	75	230	310	5532	4290	1760	1700	90	160
Sawdust*	1335	150	320	240	4032	3708	1640	1680	50	170
Straw*	1228	75	380	270	6138	5064	1040	1560	35	140
No mulch**	534	50	300	220	4872	4572	1360	1460	90	150
Sawdust**	747	150	360	170	3996	5064	1540	1440	115	135
Straw**	1015	50	420	190	6918	4668	1200	1120	100	115

[1] Leaf petioles
[2] Estimation only with 0·2 per cent diphenylamine.
* Sampling date July 10
** Sampling date July 25

Briefly, mulching appears to increase nitrogen, phosphorus and potassium content of raspberry plants with the exception of potassium where sawdust was used. Strawberry plants were found to have very little soluble nitrogen in either the leaves of petioles, but the sawdust-treated series was relatively high in nitrogen content. Unlike the raspberries there was a decrease in phosphorus content between samplings in the strawberries and it should be noticed that they contained relatively high amounts of magnesium. It is clear from the records that mulching increased vigour and yields of both these crops, nevertheless it is apparent from Table 30 that they differ markedly in respect to nutrient uptake.

Cucumbers

A survey of twelve cucumber plantings was made in order to ascertain the nutritional status of this crop under a variety of conditions. It was found that the poorest plantings were associated with a low phosphorus level, 20 to 30 p.p.m., in contrast to 100 p.p.m. in vigorous plants, and that manure is definitely beneficial (Figures 12, 13).

Samples taken from plant varieties at the Experimental Station on three different dates were analysed, the following results being obtained.

TABLE 31.—NUTRITIONAL STATUS OF CUCUMBER PLANTS[1], VARIETY EARLY MICHIGAN, EXPRESSED AT P.P.M. SOLUBLES 1951

Sampling date	N	P	K	Ca	Mg
July 11, 1951	602	240	5352	1440	180
July 26, 1951	507	70	3702	840	125
Aug. 3, 1951	774	90	4860	1000	105

[1] Leaf petioles, third leaf.

From the above figures it will be seen that there is a striking reduction in phosphorus content between the first and second samplings and this would indicate the possible value of supplementary dressings of this element during the growing season.

Figure 12. Cucumber plants grown with the addition of barnyard manure.

Figure 13. Cucumber plants grown without the addition of barnyard manure.

Analyses of potatoes and corn were also made at intervals during the growing season.

TABLE 32.—TISSUE ANALYSES OF POTATOES AND CORN (EXPRESSED AS P.P.M. SOLUBLES) 1951

Crop	Variety	Sampling date	Stage	N	P	K	Ca	Mg
Potato	Irish Cobbler	July 11	Pre-flower	854	180	8592	740	140
		July 26	Flowering	668	110	12816	420	115
		Aug. 8	Flowering	668	30	8586	680	90
Corn	Big Mo	July 11	Pre-flower	1271	230	6828	820	150
		July 26	Flowering	1175	40	7128	360	170
		Aug. 8	Flowering	934	60	5340	620	165

Table 32 shows that there is a marked decrease in phosphorus content of both potatoes and corn. The importance of this reduction in phosphorus content was demonstrated during the dry summer of 1949, when visual symptoms of phosphorus deficiency appeared. With potato plants there was a marked purpling of the leaf petiole and leaf veins, and analysis showed that affected plants contained only 8 p.p.m. soluble phosphorus. Affected sweet corn plantings showed a purplish reddening of the leaf margins with levels of phosphorus ranging from 20 to 50 parts per million. In one severely affected three-acre block which had been planted about six weeks, a supplementary side dressing of 400 pounds per acre of superphosphate served to correct the condition.

Magnesium deficiency is common in the Annapolis Valley, particularly in wet years. The disorder first appears as a yellowing between the leaf veins, followed by irregular dark brown patches. Samples of leaves removed from a ten-acre field of Green Mountain potatoes which was severely affected showed an average level of 45 parts per million magnesium. The sampling was done approximately one month after emergence and the condition was corrected with three sprays of magnesium sulphate (25 pounds to 100 gallons).

Magnesium deficiency symptoms were observed on highbush blueberries, variety Pioneer, and this was associated with magnesium levels of 105 parts per million as against 195 parts per million for normal leaves.

TABLE 33.—ORCHARD NUTRIENT SURVEY, McINTOSH, 1950

—	Orchard treatments					Average of 15 McIntosh orchards
	1 Sod. Manure 3 lb. am. nit. per tree	2 Sod, 20 lb. 9-9-7 per tree	3 Sod, 30 lb. 9-9-7 per tree	4 Sawdust, 600 lb. per acre 3-12-6	5 Sod, 10 lb. 9-9-7 per tree	
Per cent organic matter	10·4	6·6	7·4	10·2	5·4	6·3
Acidity, pH	4·00	4·5	4·5	6·0	6·0	5·0
Conductivity	29·0	60·0	58·0	12·0	10·0	24·0
Soil, pounds per acre, NO_3	33·0	59·0	43·0	15·0	13·0	25·6
P	31·0	29·0	75·0	57·0	29·0	33·7
K_2O	184·0	302·0	150·0	279·0	62·0	150·0
Ca	1820·0	1300·0	3720·0	4800·0	1480·0	2070·0
Mg	117·0	75·0	100·0	175·0	87·0	101·0
Leaf tissue—per cent dry matter N	2·02	1·94	2·40	2·07	1·86	2·1
P	0·18	0·20	0·21	0·14	0·12	0·15
K	2·02	1·58	1·30	1·39	1·18	1·43
Ca	0·86	1·05	1·42	1·15	1·09	1·01
Mg	0·19	0·17	0·21	0·18	0·14	0·17
Weight grass in pots (grams)—						
Untreated	5·5	7·1	12·8	7·5	3·9	7·3
Treated CaP*	14·3	8·8	13·2	14·4	10·6	10·9
Ratio treated/untreated	2·4	1·2	1·0	1·9	2·7	1·5
Weight clover in pots (grams)—						
Untreated	27·0	29·2	40·7	44·0	32·2	28·4
Treated CaP	44·0	42·2	30·7	41·7	41·9	40·6
Ration treated/untreated	1·6	1·45	0·9	0·9	1·2	1·4

* Based on 1000 lb. superphosphate per acre, 2 tons dolomitic limestone.

Orchard Survey

The data gathered by means of the fertility survey of McIntosh and Spy apple orchards are providing a basic picture of the major factors governing tree vigour and fruit quality. The scope of this work, indicated in Table 33, has in some cases proved useful to the participating growers. Observa-

tions are shown from five different orchards together with averages obtained from fifteen orchards. In addition to soil and leaf analyses, greenhouse trials were conducted in order to study the responses of Kentucky blue grass and red clover to various treatments accorded to the different orchard soils. Nine treatments of calcium and superphosphate were used but only the normal field treatment is included and it will be seen that the yield response, on the average, is very marked.

It may be noted that these figures show a striking correlation between soil conductivity and nitrate content, but it should be pointed out that the five orchards listed were picked at random and others in the group do not show the same relationship. Nevertheless, the relationship deserves closer study.

As these investigations are still in the preliminary stages, no further comments on the data can be made except that it is proposed to obtain soil moisture levels in these orchards by means of a recently acquired moisture meter. With the active liming program and the increased awareness of the need for organic matter, new problems in respect to crop production will appear with the change in nutritional status of the soil and plant.

Winter Rye

Where stable manure is in short supply it is now an established practice to sow winter rye and turn it down in the spring in order to build up the organic-matter content of the soil. In the early spring of 1949 attention was called to a field of winter rye at Berwick, Nova Scotia, which showed very poor growth and deep purplish leaves, analyses of which indicated severe phosphorus deficiency (35 parts per million). The following table shows the phosphorus content in leaf samples from four different positions in the Berwick field and similar data from a field on the Experimental Station.

TABLE 34.—VARIATION IN PHOSPHORUS CONTENT OF WINTER RYE (P.P.M. SOLUBLE PHOSPHORUS). SAMPLED MAY 24, 1951

Location	Positions in field			
	1	2	3	4
Berwick	104	101	35	83
Experimental Station	270	220	220	240

The winter rye at the Station was an excellent stand and the following averages of nutrient levels were obtained (parts per million solubles).

N	P	K	Ca	Mg
197	237	5675	660	102

The possibility that the rapid analysis of winter rye plants in the early spring might serve as a useful guide to subsequent crop requirements will be further investigated.

POULTRY

B. F. Cheney

All investigational work during the years 1947 and 1951 was done with a flock of single-comb White Leghorn hens maintained at the Kentville Station. Brief summaries of the findings during this period are given below.

Pedigree Breeding for Egg Production

A careful check has been kept of the production records of different families of birds, for the purpose of determining the best ones to be retained as breeders. During this period the flock operated under the Record of Performance Policy, and from 1946 to 1950 surpassed all individual breeders in Canada in the number of qualified progeny-tested birds. The total number passing the progeny test during the 5-year period were 55 males (93·2 per cent) and 261 females (83·4 per cent).

Shell Quality as Related to Hatchability, Chick Liveabilty, Egg Production and Adult Mortality

The question of whether there is a relationship between the penetrometer (Fig. 14) reading of eggs, their hatchability, the liveability of the chicks, and the liveability and productiveness of the pullets, has been investigated over the five-year period, 1947 to 1951.

The birds in the breeding pens at the beginning of this period were divided into three groups: (1) heavy shells, (2) controls, and (3) thin shells. Their progeny were maintained separately throughout the experiment. Selection of each group of hens for breeding purposes was based on their shell strength during their first year of production, using only those above and below the mean respectively in the thick- and thin-shelled groups. During this period no pullets were used as breeders.

Only cockerels were used as males in the breeding pens, and these were selected on the basis of the shell thickness of their dam, and where possible of their full sisters. Due to the small number of birds under test the shell thickness of eggs laid by full sisters could be used only to a limited extent.

The control group was selected on the basis of egg production without any regard for shell quality.

The results of this selection for thick- and thin-shelled laying lines of birds are shown in Table 35.

TABLE 35.—AVERAGE PENETROMETER READINGS OF THE PROGENY OF THE THREE GROUPS OF BIRDS, 1947-1951

Shell Group	Shell Thickness				
	1947	1948	1949	1950	1951
Thick	15·3	14·3	16·7	15·0	14·6
Control	15·2	13·9	14·9	14·2	13·3
Thin	15·1	12·9	14·6	13·6	12·7
Difference of Thick-Thin	0·2	1·4	2·1	1·4	1·9

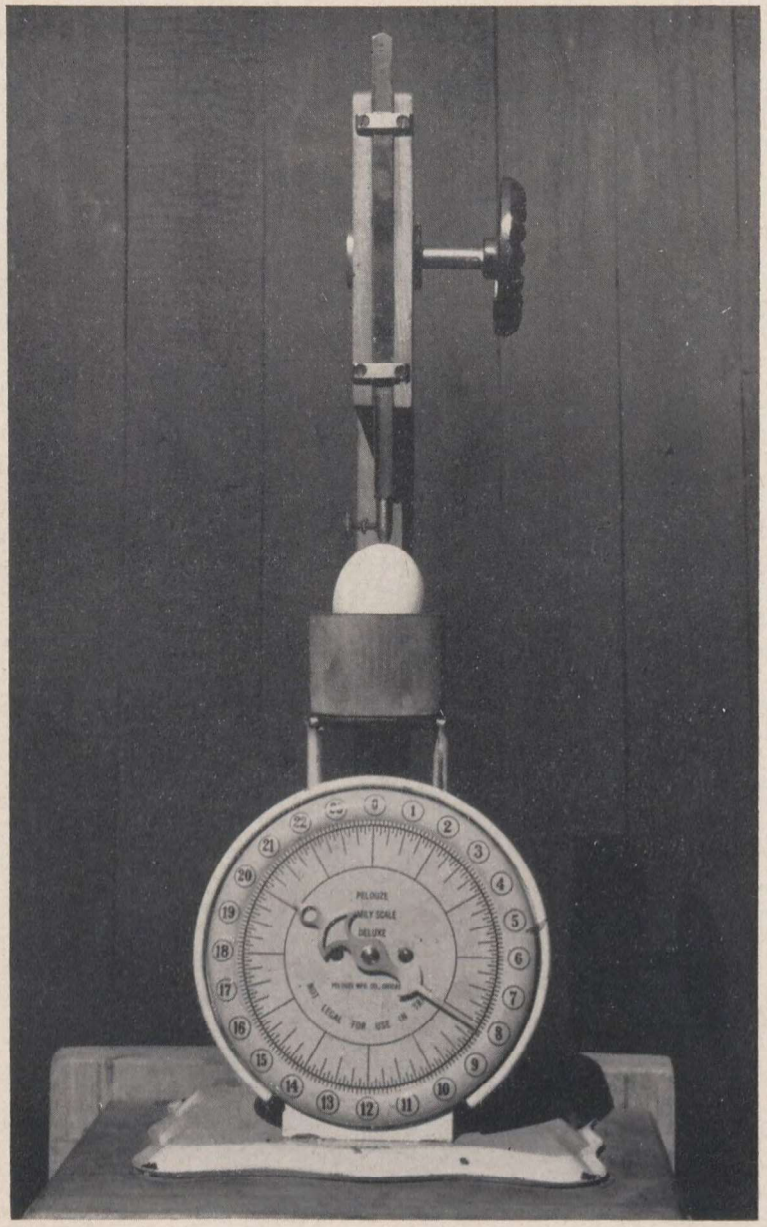


Figure 14. The eggshell penetrometer. This instrument was developed at the Kentville Station to give a numerical reading of the shell strength in grams pressure.

The results indicate that selection is effective and that it is possible to obtain lines which produce thicker or thinner egg shells by selective breeding.

Reciprocal Cross Matings

Following the regular breeding season in 1950 the males for the heavy- and thin-shelled lines were reversed, and the pullets resulting from these crosses checked for shell thickness.

The results are shown in Table 36.

TABLE 36.—AVERAGE PENETROMETER READINGS OF THE PULLETS FROM RECIPROCAL CROSSES BETWEEN THE THICK- AND THIN-SHELLED LINES, 1951

Cross.	Shell Thickness	
	Dams	Pullets
Thick-Shelled Females × Thin-Shelled Males	15·0	15·7
Thin-Shelled Females × Thick-Shelled Males	13·6	15·0

It seems to be clearly indicated that the inheritance of shell thickness is a dominant character and if crosses are made between thick- and thin-shelled lines will produce pullets that lay thick-shelled eggs. Also the fact that both the male and the female transmit this character equally rules out the possibility that the genes are sex-linked.

TABLE 37.—SHELL QUALITY AS RELATED TO HATCHABILITY AND CHICK MORTALITY, 1947-1951

Year and shell group	Per cent fertile eggs	Per cent hatch of total eggs	Per cent hatch of fertile eggs	Mortality to 3 weeks
1947				
Thick	93·7	70·3	75·2	2·9
Control	95·0	66·3	69·8	3·6
Thin	84·9	62·3	73·3	2·9
1948				
Thick	97·2	76·2	78·4	3·5
Control	96·4	65·3	67·7	4·4
Thin	95·0	65·8	69·2	5·2
1949				
Thick	97·8	59·4	60·1	4·0
Control	97·8	66·8	68·4	2·9
Thin	96·7	65·7	68·0	2·8
1950				
Thick	87·6	75·9	86·7	1·8
Control	96·1	78·4	81·7	1·2
Thin	83·9	68·7	81·9	2·2
1951				
Thick	92·7	76·8	82·9	1·6
Control	94·6	72·8	76·9	3·9
Thin	91·5	75·2	82·3	0·9
Average				
Thick	94·7	70·9	74·9	2·9
Control	96·0	69·4	72·3	3·2
Thin	91·2	67·9	74·5	2·8

This fact has considerable practical application to the production of cross-bred pullets that will lay thick-shelled eggs. These experimental results indicate that if either one of the lines used in the cross is selected for thick-shelled eggs it will produce pullets which lay thick-shelled eggs. Further, it does not make any difference whether this selection is made in the male or the female line.

Effect of Shell Thickness on Hatchability and Chick Liveability

The relationship between the factor of shell thickness and hatchability and chick liveability has been studied during the five-year period. Early results indicated that the thick-shelled line had higher hatchability and better liveability, but later results have shown considerable variation. This may simply indicate that chance fluctuations have occurred as a result of breeding in a small population of birds. The data are presented in Table 37.

Effect of Shell Thickness on Production

During the five-year period, records have also been kept of the egg production and related factors in the three shell thickness groups (Table 38). While there has been considerable variation from one year to another the thin-shelled line has each year averaged higher than the thick-shelled line, both on the basis of the number of birds housed and the number surviving. The average egg weight was at the same time slightly less in the thin-shelled group.

While production records in the small poulations are subject to variation from many factors it would seem that the ability to lay thick-shelled eggs is associated with somewhat lower production.

TABLE 38.—SHELL QUALITY AS RELATED TO EGG PRODUCTION.
(RECORDS TAKEN SEPTEMBER 4 OF YEAR FOLLOWING HATCHING)

Year and shell group	Number birds starting test	Egg Production		Average egg weight	Average body weight	Per cent mortality
		Hen housed average	Survivor average			
1947-48						
Thick	181	216·5	230·4	60·2	4·9	11·6
Control	195	213·3	226·3	58·7	4·6	12·3
Thin	124	240·8	247·8	58·3	4·8	6·4
1948-49						
Thick	175	207·9	228·3	59·7	4·8	16·6
Control	170	214·8	228·0	59·2	4·8	11·2
Thin	153	234·6	246·6	59·3	4·9	7·8
1949-50						
Thick	157	229·5	241·0	60·3	5·1	10·8
Control	170	233·3	250·3	59·0	4·8	12·4
Thin	223	246·3	254·1	57·8	4·8	5·4
1950-51						
Thick	134	142·7	173·6	59·8	4·9	30·6
Control	198	143·5	178·2	60·4	4·9	34·3
Thin	156	148·7	175·7	58·5	4·8	26·3
1951-52						
Thick	207	195·9	209·8	61·7	5·0	21·4
Control	182	199·4	217·0	59·6	4·9	22·0
Thin	174	215·5	231·9	60·5	5·2	17·2
Average						
Thick	170·8	198·5	216·6	60·3	4·9	18·2
Control	183·0	200·9	220·0	59·4	4·8	18·4
Thin	166·0	217·2	231·2	58·9	4·9	12·6

In contrast to earlier findings it appears also to be associated with a higher mortality rate in adult birds, though here again it may be a chance fluctuation because of the small number of birds or the unfortunate choice in the early years of the period of a male bird that transmitted lower liveability to his progeny.

Tests of Shell Strength in Commercial Flocks

Four commercial flocks were divided into heavy-shell and light-shell groups in 1948, in order to test the hatching results in the two groups.

The three heavy breeds had the following average penetrometer readings: Barred Plymouth Rock, 12; Rhode Island Reds, 11·5; Light Sussex, 12·7. It was decided to divide the birds at 12 on the penetrometer, which represents 840 grams pressure and is equivalent to approximately 1·078 specific gravity. Birds 12 and over were placed in the thick-shell group, and all birds below 12 in the thin-shell group. The Single-comb White Leghorns were divided at their mean of 14, equivalent to approximately 1·082 specific gravity.

The results (Table 39) indicate a distinct advantage in selecting as breeders those above the average in shell strength, in view of the higher hatchability and larger families resulting from such selection.

TABLE 39.—SHELL QUALITY AS RELATED TO HATCHABILITY AND FAMILY SIZE IN DIFFERENT BREEDS, 1948.

—	All breeds		S.C.W.L.		B.P.R.		R.I.R.		L.S.	
Shell group	Thick	Thin	Thick	Thin	Thick	Thin	Thick	Thin	Thick	Thin
Breeders	236	342	40	40	53	53	65	149	78	100
Eggs set	5384	6661	926	698	1046	845	1592	3107	1820	2011
Chicks	3993	4465	706	459	809	641	1337	2211	1141	1154
Per cent hatch	74·1	67·0	76·2	65·8	77·3	75·9	84·0	71·2	62·1	57·4
Chicks per breeder	17·1	12·4	17·7	11·5	15·3	12·1	20·6	14·6	14·6	11·5
Per cent hens with 15 or more chicks	65·7	43·9	75·0	42·5	47·1	32·1	83·1	55·0	59·0	34·0
Hatching period			6 weeks		8 weeks		5 weeks		5 weeks	

Effect of Production on Shell Strength

To determine the effect of production on shell strength an analysis was made of all birds under test for 1947, 1948 and 1949. Penetrometer readings were taken in November and again in June. The birds have been grouped according to the number of eggs produced between November 28 and June 12. The figures below are the averages for the various groups.

TABLE 40.—EFFECT OF PRODUCTION ON SHELL STRENGTH, 1947-1949

Birds tested	Production, Nov. 28	Production, Nov. 28-June 12	Penetrometer, Nov. 28	Penetrometer, June 12	Penetrometer loss
68	39·6	up to 100	1057	980	77
197	40·6	101-125	1022	931	91
529	40·4	126-150	1022	910	112
582	39·4	over 150	1001	868	133

All groups were at approximately the same production level at November 28. The initial penetrometer reading was found to be lower for the heavier-laying groups and a further loss was recorded in the June reading. It would appear, therefore, that it is natural for the heavier-laying bird to lay an egg with a thinner shell and to lose more in shell strength, as the season advances.

Effect of Influences of Unknown Origin on Shell Quality

There is evidence that some environmental influence has a definite effect on shell strength, and that this factor can raise or lower the level of the whole flock. This change may take place after the birds have reached maturity, and pullets may have a higher or a lower reading as yearlings, depending on this outside influence.

TABLE 41.—YEARLY FLUCTUATIONS IN SHELL THICKNESS AS INDICATED BY PENETROMETER READINGS

Year	Shell group	Penetrometer reading	
		As pullets	As hens
1945		13·2	16·0
1946		15·6	16·0
1947	Thick	18·0	16·3
	Control	17·0	15·1
	Thin	15·7	14·3
1948	Thick	15·6	15·3
	Control	14·6	14·3
	Thin	13·2	13·2
1949	Thick	16·2	17·2
	Control	15·2	16·6
	Thin	13·9	15·6

It is possible that the glands that secrete the shell are very sensitive to environmental changes. This could account in part for the very evident short-term, day-to-day differences in shell strength, and quite possibly also for those of longer duration from season to season.

APIARY

E. D. Craig

During the period under review, an average of sixty colonies of bees have been kept at the Experimental Station for experimental purposes and demonstration work. (Figure 15).

Previous to 1950, poisoning of bees by arsenicals used by orchardists in the control of insect pests compelled beekeepers throughout the Annapolis-Cornwallis Valley to practice migratory beekeeping during the spraying period.

During the seasons 1950 and 1951 other spray materials less toxic to bees have partly replaced arsenicals. This condition has made it unnecessary for many beekeepers to move their colonies from the orchard area during the spray period. During the past five years, fifteen colonies have been retained each year at the Station apiary during the spray period, to determine if a practical method of controlling poisoning can be established.

During the active season, extension and demonstration work is carried on among the beekeepers in the western part of Nova Scotia.

Figure 15. These well-stocked bee hives at Kentville are being used in developing a productive, gentle strain of non-swarming Italian bees.

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.

Each year a colony was kept on scales during the active period of honey gathering, and its weight recorded 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.

TABLE 42.—HONEY FLOWS, KENTVILLE: AVERAGE OF FIVE YEARS, 1947-1951

Honey flow	Average period of bloom	Average amount of honey extracted	Average net gain shown by scales	Average number of days hive gained weight
		lb.	lb.	
Fruit bloom	May 22-June 17	Nil	26·6	6·6
Clover	June 15-July 28	108·4	88·0	19·0
Fall flow	Aug. 17-Sept. 28	54·8	72·3	18·8

It will be noticed that the average amount of honey extracted from clover is greater than the average net gain shown by the scales. This is because other minor sources of honey are available before the clovers come into bloom.

A surplus of fruit-bloom honey over that required by the bees has not been harvested since 1925. Poisoning of bees by the arsenicals used in the control of insect pests has been the main reason. None of the colonies in the apiary showed any signs of poisoning from arsenical spray in 1950, and in that year the colony on scales showed a net gain of 34·5 pounds from fruit bloom.

With very few exceptions since 1919 the average amount of honey produced by the bees during the periods of the clover flow was greater than either the fall or fruit bloom production.

During the clover flow the bees store most of the honey in the supers above the brood chambers. In the fall they reverse this procedure, storing a large amount of honey (from 30 to 40 pounds) in the brood chambers for winter consumption. If this honey stored in the brood was credited to the fall flow there would not be much difference in production between the two main sources of honey.

Queen Rearing

Queen breeding has been one of the main projects carried on in the apiary for the past twenty-five years. Its purpose has been the development of a strain of Italian bees whose queens are prolific and whose workers are gentle, well coloured, do not swarm and are good honey gatherers.

Each year since 1939 one or more colonies have had two fertile queens present during the active season. From these colonies larvae have been used to raise sufficient queens to requeen thirty colonies annually. Also, a number of queens have been sent out to beekeepers in this district.

After twenty-five years of raising queens at this Station by careful selection of the breeding stock, a strain of Italian bees has been developed which shows an increasing number of two-queen hives and has no tendency to swarm. The bees in addition are gentle and are good honey gatherers.

Special Feeding during the Spray Period

In 1947 a project was started to discover a practical method of handling bees to avoid poisoning during the period in spring when arsenical sprays are applied to the orchards. The work was based on the principle of in-hive feeding. Fifteen colonies of equal strength were used, divided into three groups of five each.

Five colonies were fed a pollen supplement consisting of pollen, soybean flour and sugar syrup. In addition sweetened water was available at all times. Another five were fed a pollen substitute consisting of soybean flour, brewer's yeast and sugar syrup, with sweetened water available at all times. The third group were not fed, nor given sweetened water.

There was some poisoning in 1947, 1949, and 1951, but not in 1948 and 1950.

TABLE 43.—EFFECT OF SPECIAL FEEDING DURING THE SPRAY PERIOD ON HONEY PRODUCTION

Group (5 colonies each)	Average number combs covered last of May	Average number combs covered last of June	Total amount honey produced	Average amount honey produced, per hive, annually
			lb.	lb.
Results for the "No-poisoning" years 1948, 1950.				
Pollen supplement	10·6	21·5	468·0	93·6
Pollen substitute	10·4	22·3	348·5	69·7
Control	11·2	22·1	543·5	108·7*
Results for the "Poison" years 1947, 1949, 1951.				
Pollen supplement	9·8	16·76	419·3	83·9
Pollen substitute	10·6	12·15	279·0	55·8**
Control	10·4	13·26	279·0	55·8

* Included one outstanding hive (1948) producing 344 pounds.
** Two-year average only.

The non-poisoning probably can be attributed to the very dry weather during the latter part of May and the first three weeks of June. In the past the most severe poisoning has occurred immediately following a rainy spell.

During 1947 and 1949 none of the colonies in the pollen-supplement group showed any signs of poisoning, while the other two groups were heavily poisoned. In 1951 all the colonies in the three groups showed signs of poisoning, but in varying degrees. The pollen-substitute and control colonies suffered the heaviest losses in bees and brood. One control colony died from the effects of poisoning and one pollen-substitute colony was so weakened that it did not store a surplus of honey.

The results of this project indicate that pollen supplement may be of practical value in reducing poisoning by arsenicals during the tree fruit bloom period.

Wintering Bees in Quadruple Cases vs. Cellar Wintering

A test of the above 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 feeding was completed, four colonies were placed in each quadruple case. Four inches of dry planer shavings were used for insulation between the hive and the case, with a tunnel left through the packing 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 inside the latter part of November. During the winter the humidity and temperature were recorded weekly.

The 1947-1951 records are shown in Table 44.

TABLE 44.—COMPARISON OF WINTERING METHODS: AVERAGE OF FIVE YEARS, 1947-1951

Method	Average number of colonies	Average number of combs covered in fall	Average number of colonies dead in spring	Average number of combs covered in spring
In quadruple cases	39·20	10·18	0·6	8·58
In cellar	13·20	10·30	0·2	7·86

It will be seen that there was very little difference in the strength of the two groups of colonies when they went into winter quarters, and that the slight difference in the strength of the colonies in the spring was in favour of those wintered in quadruple cases.

The average relative humidity in the cellar during the five years was 76·1, and the average temperature 38·1°F. The lowest temperature recorded was 34·6°F. It is generally accepted that the optimum temperature range is from 40 to 45 degrees, but the lower temperatures do not seem to have produced any harmful results.

Over a period of twenty years there has not been any appreciable difference in the strength of the two lots of colonies in the spring. The time required to pack the bees in cases in the fall and unpack them in the spring is much greater than that to carry an equal number of colonies into the bee cellar in the fall and remove them to their summer stands in the spring.

FIELD HUSBANDRY

J. S. Leefe

Experiments With Herbicides

Tests of various selective herbicides were described in the progress report of this Station published in 1947. The tests included here are an extension of those previously recorded.

Oats

Controlling cadlock, *Raphanus raphanistrum,* in oats seeded with grass-clover mixtures is the principal problem in this district. A number of materials have been tested for this purpose in the years under review. The treatments were made on oats seeded to red clover, when (1) oats were 6 inches tall or (2) cadlock was in full bloom. A summary of the results is given in the following table.

TABLE 45.—YIELD OF OATS AND RED CLOVER HAY ON PLOTS TREATED WITH HERBICIDES FOR CONTROL OF ANNUAL WEEDS

Material used	Yield of oats, bushels per acre				Clover hay, tons per acre		
	1948		1949		1950		1951
	Oats 6 inches tall	Cadlock in full bloom	Oats 6 inches tall	Cadlock in full bloom	Oats 6 inches tall	Cadlock in full bloom	Oats 6 inches tall
Amine salt of 2,4-D							
2 oz. acid per acre	29·2	15·5	28·5	30·0	1·68	1·39	2·72
4 oz. acid per acre	24·4	16·0	21·5	28·5	1·20	1·29	3·36
8 oz. acid per acre	29·4	22·8	30·0	24·0	0·46	1·20	3·55
Ester of 2,4-D							
2 oz. acid per acre	21·2	14·5	28·5	27·0	1·39	1·68	2·52
4 oz. acid per acre	24·3	15·5	28·5	28·5	1·15	1·68	2·20
8 oz. acid per acre	27·2	13·0	27·0	33·0	1·15	1·11	2·27
Ammonium DNOSB 17·6% solution							
3 qt. per acre	29·9	10·7	36·0	37·5	1·54	1·15	.....
1½ qt. per acre	27·2	14·0	42·0	31·5	1·88	1·92	.....
Calcium cyanamid dust							
100 lb. per acre	.....	.....	39·0	37·5	1·54	1·20	.....
Sodium cyanamid spray							
50 lb. per acre	.....	.....	34·5	34·5	1·82	1·44	.....
Untreated	.....	.....	.....	.....	1·01	1·17	2·78

Because of the low cost of materials and ease of application in low volume, amine and ester formulations of 2,4-D are generally popular with farmers.

In 1948 very poor control of cadlock was obtained by spraying after the weeds were in the bloom stage. This was reflected in the lower yield of oats obtained. In 1949, which was a wet season, there was no difference in yield between treatment dates, but the relative weed control was much less at the late treatment date. In 1950 the grain plots in this test were so badly damaged

by a wind and rain storm that it was not possible to obtain yields. The untreated plots in 1948 and 1949 were so badly infested with cadlock that the grain was not worth threshing. All the materials used gave some control of cadlock if applied at a time when the oats were six to eight inches tall. Less than four ounces of 2,4-D acid per acre did not give sufficient control to be useful, but more than four ounces did not appear to be necessary.

Injury to new seeded red clover is difficult to evaluate. The high rates of 2,4-D have not always reduced yields of hay the year following treatment, and in 1950 one of the lowest yields was obtained when no treatment had been applied the previous years. In 1951 the hay yields on the plots treated in 1950 with the ester formulation were definitely lower in yield than those treated with the amine formulation. This effect was not generally noticeable the previous year. The dinitro compounds (DNOSB) have given good results in this work, but because they are more expensive and unsatisfactory to apply in low volume they are not recommended in preference to 2,4-D.

Peas

The control of broad-leafed weeds, particularly cadlock, in peas grown for processing, presents an important problem. Some preliminary work was reported in the last published report of the Station. This preliminary test dealt with the use of Dow's Selective Herbicide, a contact weed killer containing ammonium dinitro-ortho-secondary butyl phenol. This material belongs to a class of chemicals commonly called "the dinitros" and referred to officially in Canada as DNOSB, and is available in several formulations.

Since the report referred to above was published much interest has developed in a type of weed control known as "pre-emergence", particularly with large seeded crops. This system, as the name suggests, involves the application of a chemical to the soil prior to the emergence of the crop plants with the purpose of killing germinating weed seeds.

A number of chemicals which appeared promising have been tested for both post-emergence and pre-emergence application during the period under review.

For post-emergence weed control in peas it is necessary to use an herbicide that kills by contact, the selective action depending on the fact that the weeds are wetted but the peas, because of the waxy leaf surface, are not. Some injury to the peas usually results. The growth-regulating types of herbicides, such as 2,4 D compounds, are useless since they kill the peas.

Of the post-emergence treatments used, the ammonium DNOSB has been the most successful where control of cadlock is involved. Results have not been consistent, good control only being obtained when the spray was applied during hot dry weather. During damp cool weather sprays gave poor kills, particularly if cadlock was approaching the bloom stage. One and one-half quarts of a 17·4 per cent solution of ammonium DNOSB in 35 gallons of water per acre has given adequate control when conditions were right. Double this concentration did not give improved control. Much higher dosages have been used locally by commercial growers, in one case five quarts per acre in 40 gallons of water. This was applied to a field infested with cadlock in full bloom. Control was excellent but severe injury resulted to the peas.

For pre-emergence weed control it is necessary to use a chemical that will kill germination weed seeds, but will not affect the germinating peas if applied a few days before they emerge. In addition the effect of the treatment should be as long lasting as possible.

In the period under review several compounds have been used. These included compounds of 2,4-D, both volatile and low volatile esters, granular calcium cyanamid and an amine salt of DNOSB.

Figure 16. Rough land pasture before treatment. Such pastures are full of bushes and contain little grass.

Figure 17. Rough land pasture after treatment with herbicides and the application of commercial fertilizer. Note the elimination of bushes and the vigorous growth of new grass.

Cyanamid at rates of 200 to 400 pounds per acre, and compounds of 2,4-D at 3/4 pound acid per acre have both given good initial control, but are by no means long lasting in effect. When 2,4-D was used at 1 1/2 pounds per acre, severe injury to peas resulted. Using a 54 per cent solution of amine salt of DNOSB at the rate of four to eight pounds in 35 to 40 gallons water per acre has given excellent results and practical freedom from weeds up to harvest time. Tests in 1951 indicated that four quarts per acre were sufficient to give good weed control.

Renovation of Rough Land for Pasture

Some preliminary work has been undertaken to examine the possibility of renovation of rough land for pasture by the combined use of herbicides and commercial fertilizer. Many acres of such land exist in Nova Scotia. Much of this land was cleared and cultivated at one time and is now in the process of reversion to bush.

Preliminary tests indicate that moderately heavy applications of commercial fertilizer combined with a spray of brush-killing herbicides will promote a good growth of pasture herbage (Figs. 16, 17) and rapidly eliminate woody perennials such as grey birch (*Betula populifolia*), alder (*Alnus* sp.), bayberry (*Myrica pennsylvania*) and common juniper (*Juniperus communis*).

Further tests are under way to determine the amount and kind of herbicide best suited for this work.

Experiments with Grass Silage

Grass and grass-legume mixtures have been ensiled (Fig. 18) in small quantities in the past. In the main, however, corn and roots have provided the principal winter succulent feed for dairy cows at the Station. As a result of preliminary work in the ensiling of grass in 1947, it was decided in 1948 to cease the growing of roots and corn and depend entirely on "grass silage" for winter succulent feed.

It is not intended in this report to give a full account of all the work done with grass silage in the past few years. In general, however, it can be said that ensiling of grass crops successfully produces a highly satisfactory feed which reduces the amount of concentrates necessary to maintain dairy cows in winter. Table 46 gives the feed consumed per 100 pounds of milk produced by the Station herd during the winter months, for the period 1946-1951.

Table 46 shows that the grain-milk ratio has been considerably reduced as the average silage ration increased.

TABLE 46.—FEED CONSUMED PER 100 POUNDS OF MILK PRODUCED, NOVEMBER TO APRIL, 1946-1951

Year	Feed consumed per 100 pounds of milk			Average daily production
	16% Dairy ration	Silage	Hay	
	lb.	lb.	lb.	lb.
1946	34	64*	75	18·13
1947	39	71	78	18·28
1948	39	92	69	18·71
1949	32	114	70	16·93
1950	28	181	40	21·12
1951	13	431	28	17·52

* Partly corn silage.

The question of whether or not to add a "preservative" when ensiling grass-clover mixtures is being investigated. Mixtures containing no preservative have been compared for two successive years with molasses, ground oats and apple juice concentrate. There is some evidence that the addition of 30 pounds of molasses per ton of green material produces a more acid silage than where no molasses is used. The quality of the molasses silage as judged by odour and palatability has not been superior to silage made with no preservative.

Figure 18. This trench silo at the Experimental Station, Kentville, is filled with grass silage packed down with a tractor, and covered with a layer of sawdust.

The crude protein content of the silage has varied considerably from a low of 10 per cent of the dry matter, where timothy in the early-heading stage was used, to a high of 17.8 per cent, where a nearly pure stand of ladino clover was ensiled. Generally, where mixed stands of clover and grass are used the crude protein of the dry matter has ranged from 12 to 13 per cent.

The effect of moisture content at the time of ensiling has not been studied specifically. Moisture contents have varied from a low of 65 per cent to a

high of 80 per cent. High moisture content has not adversely affected quality, as judged by odour and palatability, but low moisture content has at times caused spoilage by moulding.

The question of the losses, apart from spoilage, that occur during the ensiling process has been studied, but lack of adequate scales for weighing heavy loads made it impossible to obtain definite information on this point. Estimates have been made which indicate that dry-matter losses may vary greatly, and at times be as high as 30 per cent of the dry matter put in the silo. Our greatest loss occurred in a small upright silo of 30-ton capacity. It is difficult to get good consolidation of the silage mass in a small silo, and this probably results in rather high temperatures, resulting in excessive dry-matter loss.

Observations on the relative efficiency of silage-making versus hay-making have been made. Under the climatic conditions existing in Nova Scotia it is not usually possible to make hay as early in the season as it is to cut silage. During the period 1948-1951 silage making at the Station has taken place from June 10 to 20. Because the protein content lessens as the hay approaches ripeness, the earlier cutting and ensiling gives a larger amount of protein, as shown in Table 47. In this comparison a uniform field of timothy and clover was divided, one-half being cut for hay July 15, and the other half cut for silage June 18, and again for hay August 9.

TABLE 47.—COMPARISON OF HAY AND SILAGE FOR CRUDE PROTEIN CONTENT

Plot	Method	Yield dry matter per acre	Yield crude protein per acre	Per cent crude protein*
		lb.	lb.	%
1	Silage, June 18	3200	434·9	13·59
	Hay, August 9	2300	257·8	11·06
2	Hay, July 15	4140	310·5	7·5

* The crude protein was determined on samples from plot 1, but not from plot 2. The figure given for plot 2 is from Morrison's Feeding Standards for Timothy-clover Hay of Good Quality.

Table 47 shows that the amount of protein salvaged from an acre is likely to be higher from the first crop cut early for silage than from the crop cut later for hay. Usually early cutting for silage allows a second crop which can be taken for hay or silage, or better still, pasture good enough for dairy cows. The aftergrowth following cutting for hay seldom is sufficient for good pasture.

ANIMAL HUSBANDRY

R. H. McDowell

During the period 1947-1951 a herd of purebred Guernseys has been maintained at the Experimental Station. The size of the herd has averaged about 45 head, and the animals have been used for both demonstration purposes and experimental work.

A bad outbreak of brucellosis in 1950 caused the loss of the herd sire, 24 cows and six heifers, and seriously disrupted some of the long-term experiments.

Grass Silage for Milking Cows

In the winter of 1949-50, the cows available were divided into lots of six animals each, and fed as follows:

TABLE 48.—FEEDING SCHEDULE FOR HAY, GRASS SILAGE, AND GRAIN, 1949-50

Cows	Hay Daily per 100 pounds liveweight	Grass silage Daily per 100 pounds liveweight	Meal 16% grain per 3½ pounds milk
	lb.	lb.	lb.
Lot 1	1	3	1
Lot 2	½	4½	1
Lot 3	0	6	½

Table 49 gives the amounts of feed eaten and shows that Lot 2 had the least decrease in milk production, and Lot 3 the most. The cost to produce 100 pounds of milk was lowest in Lot 3, and highest in Lot 1. Feed during the test was valued at: hay, $20.00; grain, $74.00; and silage, $5.00 per ton.

None of the lots gained or lost weight during the test. The results suggest that considerable amounts of silage may be fed in place of hay.

TABLE 49.—FEED CONSUMPTION AND MILK PRODUCTION BY COWS ON GRASS SILAGE, 1949-50

	Total feed eaten			Milk production			Feed to produce 100 pounds milk
				Daily average per cow at start	Average decrease		
	Hay	Silage	Grain		At 7 weeks	At 14 weeks	
	lb.	lb.	lb.	lb.	%	%	$
Lot 1	4080	12416	2947	28·2	19·2	25·7	2·02
Lot 2	1940	17852	3089	28·3	12·4	13·4	1·82
Lot 3	0	25996	912	22·9	26·0	29·5	1·42

In 1950-51, the two-year-olds were divided into two lots of three each. Lot 1 received daily, per animal, 8 pounds of hay, 40 pounds of silage, and in addition 1 pound of grain to each 3½ pounds of milk produced. Lot 2 had hay and silage in front of them at all times and no grain. During the last four weeks of the test the hay was of such quality that the cows in Lot 1 would not consume their full allotment, so the amount of silage fed to these cows was increased correspondingly. While significant differences in milk production of

the two lots were not obtained, it was shown that the cost of producing milk was much less when grass silage was used as the main feed. Table 50 gives the results of the 84-day test.

TABLE 50.—FEED CONSUMPTION AND MILK PRODUCTION BY HEIFERS ON GRASS SILAGE, 1949-50

	Hay	Silage	Grain	Milk production, average per cow		Total milk for 84 days	Feed cost to produce 100 pounds milk
				Week previous to test	Last week of test		
	lb.	lb.	lb.	lb.	lb.	lb.	$
Lot 1	952	17255	1386	25·1	22·0	6078·0	1·71
Lot 2	1804	17646	.....	25·2	22·6	5908·2	1·05

Loose-pen Stabling of Dairy Cows

In the summer of 1950 the main barn was remodelled to the loose-pen system by taking out the stanchions and iron work and constructing a manger across the center. This made an open area of 44 x 46 feet. The manger was built 34 inches from the floor in front, with the back 14 inches higher. The posts and headrails of the old stanchions were used on top of the pen side of the manger and spaced off with openings at 22-inch centers for each animal. This made enough space for 24 cows to feed at a manger 44 feet long.

This system of stabling has been found to be satisfactory. The cows seemed more comfortable, and in fine weather were able to go outdoors at will. The cows were cleaner and required less currying than in the stanchion barn. Boss cows made no trouble at feeding time since all the cows were dehorned.

About twice the former amount of bedding was used. Alternate layers of shavings and straw kept the manure-pack dry and solid.

Cleaning of the pen was done the last of December and again in May, by means of a tractor with a fork mounted in front. The average temperature of the manure throughout the winter was 78°F. four inches down from the top of the manure-pack.

A milking parlor was built on the outside of the stable, with three stalls for milking. The walls and ceiling were insulated and covered with Donnacona board. A 2,000-watt electric strip-heater with thermostatic control was installed, and this kept the room at an average temperature of 50°F.

This loose-pen stable has cut the labour down approximately 10 per cent, supplies more comfort for the cows, and permits the making of a better manure with no losses in liquid run-off. The cows soon get used to the routine of going through the milking parlor. At that time extra grain can be fed to the higher-producing cows while they are being milked.

Portable Milking Parlor

A portable milking parlor was built in 1949 (Fig. 19) and is used each summer. This makes it possible to milk the cows in the pasture when the distance from the pasture to the barn is too great for easy movement of the cattle. It was constructed like the milking shed built at the stable, but is of light material and mounted on skids, making it easily hauled to the different pasture fields. This portable parlour makes it possible to turn the cows out in the spring, and not bring them in again until fall.

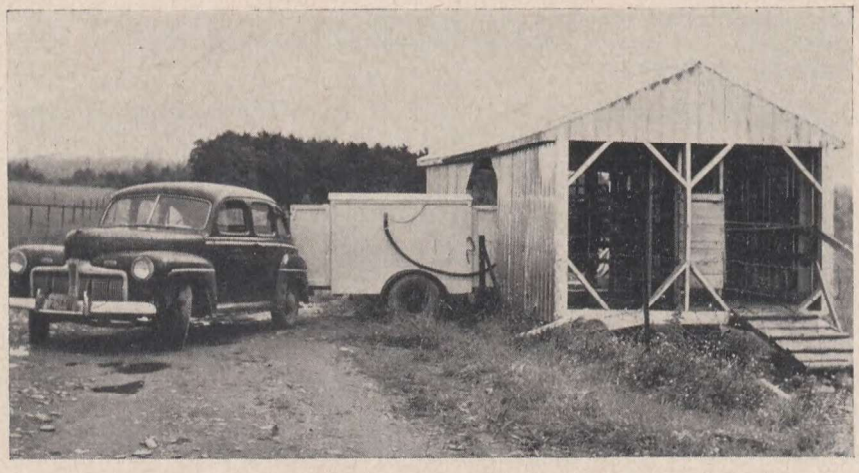


Figure 19. This portable milking parlor was constructed for use in the pasture during the summer months. It allows the use of pastures at considerable distances from the barn and saves greatly in time and labour.

Record of Performance, Guernsey

All normal cows in the herd were carried in the Record of Performance test. Twelve mature records, eight four-year-old, eight three-year-old, and fifteen two-year-old records were made in the five-year period, with an average of 8607 pounds of milk and 417 pounds fat in 338 days. The average test was 4·84 per cent butterfat.

TABLE 51.—RECORD OF PERFORMANCE, GUERNSEY, 1947-51

Number of records	Class	Average amount of milk	Average amount of fat	Average number days in milk
		lb.	lb.	
12	Mature	9483	461	331
8	4-year	8947	431	329
8	3-year	8838	404	345
15	2-year	7602	381	343
Average		8607	417	338

Cost of Raising Female Calves, Guernseys

The cost of raising female calves to one year old, and from one year to freshening date, was studied by keeping a strict account of all feeds consumed. The average cost to one year was $51.95, and from one year to freshening, $63.90.

ILLUSTRATION STATIONS

F. B. Kinsman

Agricultural experiments have been conducted on six Illustration Stations strategically located throughout western Nova Scotia. Work on these units complements that conducted on the Experimental Station by the procurement of experimental data on soils and under climatic conditions prevailing in farming areas outside the Annapolis Valley. During the past five years the Station at Chegoggin has ceased operations and new ones have been opened at East Stewiacke and Chebogue. The present operators and the location of their farms are as follows:

J. R. Deveau, Mavillette, Digby County
W. F. Falkenham, Lilydale, Lunenburg County
J. L. Main and Son, Noel Shore, Hants County
R. H. Zwicker, Newport, Hants County
E. G. Campbell and Sons, East Stewiacke, Colchester County
W. Haley, Chebogue, Yarmouth County

The operators of these Illustration Stations work in close co-operation with the Experimental Farm Officers, and the work on each of their farms is particularly designed to study the important local agricultural problems.

In addition to the above mentioned regularly organized Illustration Stations there is a small unit devoted to the study of cranberry production. This Station is located at Aylesford and the work on it is reported under the Native Fruits section of this report.

Farm Planning and Crop Rotations

Considerable work has been done, in co-operation with the operators, in the planning of production on these farms. The tillable area on each farm has been divided into rotational areas of approximately equal size. The number of rotation fields depends on the farm acreage, livestock feed requirements, and type of production required. At Mavillette where the farm is small and a high revenue per acre is required a four-year rotation of hoed crops—cereal—hay—hay is established. This rotation allows one-quarter of the work land to be in heavy production of potatoes as a cash crop on roots for feed. Another quarter of the land is in grain while the remaining one-half is in the production of mixed hay. In this short rotation the meadows are never more than two years old and thus a heavy hay harvest is usually obtained.

At East Stewiacke where the area of land farmed is quite large a seven-year rotation is followed. In this rotation cash crops are at a minimum and the major portion of the land is used for the production of hay and pasture as feed for the large dairy herd. This rotation is well suited to large farms where meadows remain productive.

On the Lilydale, Noel Shore, and Newport stations where the farms are medium in size and livestock production is the main enterprise five-year rotations are established. In these rotations three-fifths of the crop area is in hay crop production while the other two-fifths is devoted to grain and root production.

These rotations have proved well adapted to these farms and crop production has been maintained and in some cases increased.

Fertilized Pastures

In addition to the tilled land managed in a rotation there is an area of permanent pasture on each of these farms. In its natural state this pasture is unproductive and seriously limits the farm revenue. To determine how to overcome the unproductiveness of natural sod considerable work has been done on the use of fertilizers and limestone. This work has been active during the past eight years on several Stations. The following fertilizer treatments have been under study:

Treatment No.	*Treatment per acre*
1	100 lb. ammonium sulphate annually 600 lb. superphosphate every 3 years 120 lb. muriate of potash every 3 years
2	600 lb. superphosphate every 3 years 120 lb. muriate of potash every 3 years
3	600 lb. superphosphate every 3 years
4	100 lb. ammonium sulphate annually 200 lb. superphosphate annually 40 lb. muriate of potash annually
5	100 lb. ammonium sulphate annually 600 lb. superphosphate annually 120 lb. muriate of potash annually
6	Check—no treatment

These treatments are applied early in the spring on half-acre plots. Cages are located on each plot to protect an area of herbage from stock. The herbage under these cages is harvested once each month during the grazing season for yields. The percentage of clovers, grasses, and weeds is estimated for each plot. The yields obtained to date are presented in Table 52.

A study of the results of this experiment shows that the yield of pasture has been more than doubled at Noel Shore by fertilization and more than tripled at Newport, Lilydale and Mavillette. In no case has annual fertilizer treatment proved substantially superior to treatment every three years even in treatment 5 which consists of three times as much minerals during a three-year period as treatment 1. Superphosphate has had a marked effect on yield at all Stations. Potash has had a mild effect on yield at Noel Shore and Lilydale. An annual application of nitrogen has influenced yields at each point. It will be noted that practically all fertilizer treatments have increased the clover content and that it is highest on those plots treated with muriate of potash. It has also been found on these farms that an application of ground limestone can be counted on to increase herbage yields and the clover content.

Grass and Legume Hay Mixtures

The yield of hay obtained from different seed mixtures has been under study at Noel Shore, Newport and Lilydale since 1949. Five different mixtures were seeded out on each of these Stations in 1948 and yields have been procured from the test in 1949 and 1950. The mixtures seeded out are as follows:

Mixture No.	*Mixture in lb. per acre*
1	Timothy 8 lb., Red Clover 5 lb., Alsike 2 lb., Alfalfa 5 lb.
2	Brome Grass 15 lb., Red Clover 5 lb., Alsike 2 lb., Alfalfa 5 lb.
3	Timothy 6 lb., Red Clover 4 lb., Alsike 1 lb., Alfalfa 4 lb., Ladino 1 lb., Meadow Fescue 3 lb.
4	Timothy 4 lb., Red Clover 5 lb., Alsike 2 lb., Alfalfa 5 lb., Reed Canary Grass 5 lb.
5	Timothy 8 lb., Red Clover 5 lb., Alsike 3 lb., Alfalfa 3 lb.

TABLE 52.—YIELD IN TONS OF GREEN HERBAGE PER ACRE AND PERCENTAGE OF CLOVERS, GRASSES, AND WEEDS IN FERTILIZED PASTURE TRIALS

STATION	No. of years	Treatment 1: 100 lb. Amm. Sulph. annually 600 lb. Super. 20% 120 lb. Mur. of P. every three years				Treatment 2: 600 lb. Super. 20% 120 lb. Mur. of P. every three years				Treatment 3: 600 lb. Super. 20% every three years				Treatment 4: 100 lb. Amm. Sulph. 200 lb. Super. 20% 40 lb. Mur. of P. annually				Treatment 5: 100 lb. Amm. Sulph. 600 lb. Super. 20% 120 lb. Mur. of P. annually				Treatment 6: No fertilizer			
		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
		tons	%	%	%	tons	%	%	%	tons	%	%	%	tons	%	%	%	tons	%	%	%	tons	%	%	%
Noel Shore	7	20·69	40	52	8	19·22	48	45	7	16·16	42	50	8	16·89	41	52	7	21·29	45	47	8	8·47	39	44	17
Newport	8	22·39	50	45	5	20·94	59	37	4	21·21	58	37	5	17·61	50	43	7	23·97	52	43	5	7·40	54	34	12
Lilydale	8	12·16	42	48	10	11·54	49	44	7	10·03	47	45	8	10·60	38	54	8	13·94	46	46	8	4·15	14	74	12
Mavillette	8	25·04	36	53	11	22·73	58	32	10	23·66	54	34	12	20·05	38	47	15	28·23	50	40	10	6·54	18	65	17
Average of 31 tests	.....	20·05	42	49	9	18·59	53	40	7	17·82	50	42	8	16·26	42	49	9	21·88	48	44	8	6·58	31	54	15

The yield records obtained from this study are presented in Table 53.

The different grass mixtures did not all behave the same in their manner of growth at the different Stations. At Lilydale the brome grass persisted in the soil better than at the other Stations. The ladino clover yields were outstanding at Newport, while at Lilydale it showed up very poorly. The alfalfa did not grow satisfactorily, apparently because of lack of limestone. The meadow fescue (Mixture 3) produced well, and reed canary grass (Mixture 4) while not very abundant, appeared healthy and showed vigorous growth. The highest yields were obtained from the standard mixture (Mixture 5) and that including the meadow fescue (Mixture 3).

TABLE 53.—YIELD OF HAY FROM PLOTS SEEDED TO FIVE DIFFERENT MIXTURES IN 1948

Station	Mixture 1		Mixture 2		Mixture 3		Mixture 4		Mixture 5	
	1949	1950	1949	1950	1949	1950	1949	1950	1949	1950
	Clover	Clover and Grass	Clover	Clover and Grass	Clover	Clover and Grass	Clover	Clover and Grass	Clover	Clover and Grass
	tons	tons	tons	tons	tons	tons	tons	tons	tons	tons
Noel Shore.....	2·41	2·35	2·37	2·35	2·37	2·39	2·35	2·31	2·43	2·47
Newport.....	2·47	2·49	2·28	2·37	2·53	2·58	2·41	2·30	2·53	2·56
Lilydale.....	2·54	2·57	2·51	2·55	2·56	2·61	2·33	2·29	2·50	2·59
AVERAGE.	2·47	2·47	2·39	2·42	2·49	2·53	2·36	2·30	2·49	2·54

Chemical Fertilizers

Considerable effort has been directed towards determining the most economical rate of applying chemical fertilizer to crops grown in rotation. During the past six years the effect of applying 250, 500, and 750 pounds of 2-12-6 per acre to the hoed crop as a supplement to farm manure and the effect of supplementing the 500 pound application with 2 tons of ground limestone per acre has been studied. In measuring the effect of these treatments yields are procured from the treated root crop and the succeeding grain and hay crops. This test was laid down on five Stations in 1946 and on one in 1951. The yields obtained to date are presented in Table 54.

It may be noted from Table 54 that the yields of practically all crops on all Stations have increased in proportion to the increased rate of applying fertilizer. The hoed crop yields represent the initial effect from fertilizer application while the cereal and hay crop yields represent residual effect. The initial effect on yields was much more pronounced than the residual effect. There is some indication that 750 pounds may not be the upper economic limit of application even on some mixed farms.

Ground limestone had little or no beneficial effect on hoed crop and cereal yields, but did have a marked influence on hay crops at all Stations except Noel Shore.

TABLE 54.—THE EFFECT OF RATES OF APPLYING CHEMICAL FERTILIZER ON THE YIELD OF FARM CROPS GROWN IN ROTATION

Treatment	1					2					3				
Treatment per acre	Manure 12 tons 750 lb. 2-12-6 applied to roots					Manure 12 tons, 500 lb. 2-12-6 2 tons ground limestone applied to roots					Manure 12 tons 500 lb. 2-12-6 applied to roots				
Crops and year	Turnips 46	Oats 47	Clover 48	Timothy 49	Turnips 51	Turnips 46	Oats 47	Clover 48	Timothy 49	Turnips 51	Turnips 46	Oats 47	Clover 48	Timothy 49	Turnips 51
	tons	bu.	tons	tons	tons	tons	bu.	tons	tons	tons	tons	bu.	tons	tons	tons
Station:															
Noel Shore	33·0	42·3	2·82	2·59	29·0	21·8	41·1	2·42	2·65	25·7	26·3	42·0	2·42	2·35	26·0
Newport	38·5	59·3	2·37	2·22	34·5	35·5	57·6	2·40	2·31	32·0	35·8	55·4	2·22	2·17	34·1
Lilydale	23·7	49·0	2·21	2·25	33·7	20·0	45·0	2·29	2·22	30·7	20·6	46·5	2·10	2·11	30·0
Mavillette	20·9	78·8	2·99	2·93	34·2	19·7	74·3	3·10	3·19	33·6	19·9	75·2	2·71	2·61	34·7
Chegoggin	23·7	47·3	2·10	2·00	.....	19·6	41·6	2·32	2·09	.....	19·2	39·9	2·12	1·93	.....
East Stewiacke	.....	.....	.....	.....	33·6	.....	.....	.....	.....	30·0	.....	.....	.....	.....	29·1
AVERAGE	28·0	55·4	2·50	2·40	33·0	23·3	51·9	2·51	2·49	30·4	24·4	51·8	2·31	2·23	30·7

TABLE 54.—THE EFFECT OF RATES OF APPLYING CHEMICAL FERTILIZER ON THE YIELD OF FARM CROPS GROWN IN ROTATION

Treatment	4					5				
Treatment per acre	Manure 12 tons 250 lb. 2-12-6 applied to roots					Manure 12 tons Check				
Crops and year	Turnips 46	Oats 47	Clover 48	Timothy 49	Turnips 51	Turnips 46	Oats 47	Clover 48	Timothy 49	Turnips 51
	tons	bu.	tons	tons	tons	tons	bu.	tons	tons	tons
Station:										
Noel Shore	23·0	38·0	1·92	2·18	19·4	18·6	35·2	1·95	2·22	23·9
Newport	24·9	51·7	2·01	2·07	31·0	24·3	49·3	2·11	2·08	30·0
Lilydale	17·5	41·1	1·88	1·61	25·2	17·7	42·7	1·60	1·88	28·6
Mavillette	18·0	72·0	2·70	2·28	23·0	16·5	72·1	2·62	2·25	29·6
Chegoggin	16·5	37·0	1·80	1·76	.....	15·8	38·5	1·79	1·63	.....
East Stewiacke	.....	.....	.....	.....	28·4	.....	.....	.....	.....	30·4
AVERAGE	20·0	48·0	2·05	1·98	25·4	18·6	47·6	2·01	2·01	27·4

Production of Turnips

The turnip varieties Wilhelmsburger and Ditmars were grown on all of the Illustration Stations. The former has been selected from tests of thirteen different varieties as being the best all-round turnip that is resistant to clubroot infection, while the latter is a standard variety for yield and quality. The freedom from disease is shown in Table 55 for the years 1947-50.

TABLE 55.—PERCENTAGE FREEDOM FROM CLUBROOT IN THE TURNIP VARIETIES DITMARS AND WILHELMSBURGER (AVERAGE 5 STATIONS).

Year	Ditmars	Wilhelmsburger
	% Free	% Free
1947	87·6	98·8
1948	83·5	97·5
1949	79·2	96·6
1950	82·8	96·2
Average	83·3	97·3

Another root condition being studied in turnips is brown-heart. In this case the treatment has been the use of 15 pounds per acre of boron in the form of borax. This treatment reduced the occurrence of brown-heart as is indicated by Table 56.

TABLE 56.—PERCENTAGE FREEDOM FROM BROWN-HEART IN TURNIPS GROWN ON SOIL TREATED AND NOT TREATED WITH BORON (AVERAGE 5 STATIONS).

Year	15 Pounds Boron/acre	No Boron
	% Free	% Free
1947	96·0	93·2
1948	98·5	93·0
1950	95·8	87·2
Average	96·8	91·1

Potato Varieties

As part of the research program to obtain satisfactory varieties of potatoes resistant to infection from late blight, a co-operative testing program has been carried out with the Experimental Station of Fredericton, N.B. Late blight is very prevalent in many of the coastal areas of Nova Scotia because of the high precipitation and foggy conditions. These Illustration Stations provide ideal locations to test these potatoes. About 20 numbered selections from the breeding work at Fredericton have been planted and evaluated.

Farm Management and Business Study

Crop rotations, soil management, and the inclusion of subsidiary enterprises or sidelines have an important bearing on the financial effectiveness of the farm business. In order to measure the financial success of Illustration Station operators and thus to determine the factors limiting success, farm business records are kept by each operator. At the end of each year a complete farm inventory is taken covering the farm acreage; crop production; capital investment in land, buildings, livestock, machinery and equipment; feeds and supplies; accounts receivable; and liabilities. Some of the more important phases of this study are outlined below.

Land Utilization

A summary of the land use as determined from the 1951 inventories of the five stations is presented in Table 57.

TABLE 57.—LAND UTILIZATION ON THE ILLUSTRATION STATIONS WESTERN NOVA SCOTIA—5 STATIONS

Item	Total area	Average per farm	Per cent of area per farm
Total area	920·0	184·0	100
Cropped area	388·0	77·6	42·2
Pasture	211·3	42·3	23·0
Woods and wasteland	320·7	64·1	34·8
Grain	111·0	22·2	12·1
Hay	241·0	48·2	26·2
Corn and roots	25·5	5·1	2·8
Potatoes	10·5	2·1	1·1

The total land owned by operators is 920 acres. Forty-two per cent of this land is cropped, 23 per cent is in pasture while 34·8 per cent is in woods and wasteland. The largest single crop is hay and when it is added to the pasture it is seen that these are predominantly grassland farms devoted to livestock programs.

Farm Capital

Table 58 shows that the capital invested in land and buildings varies from 18·8 to 45·7 per cent; in livestock from 14·9 to 31·7 per cent and, in machinery and equipment from 7·6 to 23·5 per cent. The gross receipts per acre of crop land vary with the area of cash crops, the size of farm, and the quality of market available.

TABLE 58.—PERCENTAGE OF CAPITAL INVESTED AND INVESTMENT PER ACRE OF CROPLAND ON ILLUSTRATION STATIONS—WESTERN NOVA SCOTIA 1951

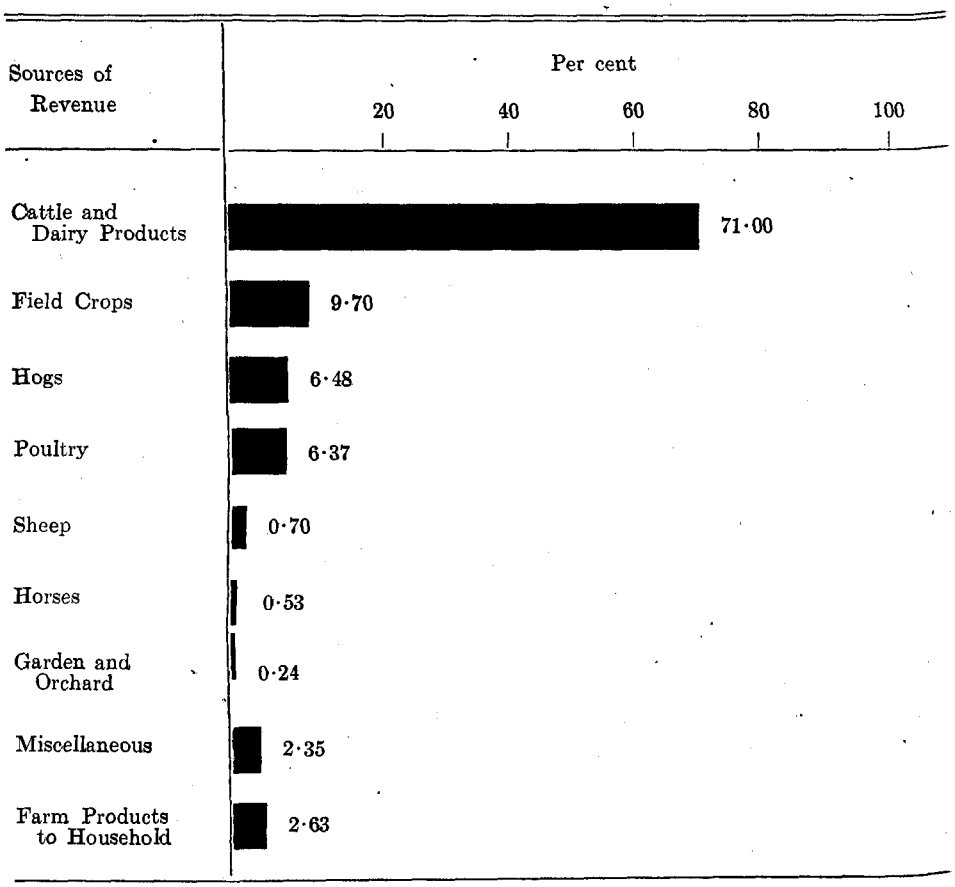
Station	Per cent of capital invested in				Investment per acre *cropland
	Land and Buildings	Livestock	Machinery and Equipment	Feeds and Supplies	
	%	%	%	%	$
Lilydale	45·7	26·1	10·9	17·3	441·12
Mavillette	27·7	14·9	7·6	49·8	528·70
Newport	18·8	26·4	23·5	31·3	277·26
Noel Shore	21·1	31·7	12·4	34·8	287·14
AVERAGE	28·3	24·8	13·6	33·3	383·55

* Cropland does not include pasture.

Sources of Revenue

A summary of business operations showing sources of revenue is drawn up as of December 31 each year. Average figures for the period 1947-1951 inclusive are summarized in the accompanying chart. It may be noted that by far the greatest source of revenue is cattle and dairy products on these predominantly livestock farms. Field crops would not be so important as indicated were it not for the fact that the operator at Mavillette specializes in potato production. Sheep are kept on only one farm.

SOURCES OF REVENUE 1947-1951 MAVILLETTE, LILYDALE, NEWPORT AND NOEL SHORE



Field Days

In order to acquaint the public with the program carried on at Illustration Stations and to bring to the attention of farmers the practical findings of the Experimental Farms Service, Field Days are held at each Station. These Field Days are sponsored by the Experimental Farms Service in co-operation with the Provincial Department of Agriculture. The Illustration Station thus serves as a focal point where farmers may view projects, converse with Departmental representatives, discuss mutual problems, and seek advice.

EXPERIMENTAL PROJECTS ACTIVE AT EXPERIMENTAL STATION

KENTVILLE, NOVA SCOTIA

Animal Husbandry

A. 58	Record of Performance, Guernseys.
A. 59	Periodic Costs of Rearing Dairy Females.
A. 93	Control of Tuberculosis in Cattle.
A. 217	Cost of Maintaining Dairy Herd Sires.
A. 331	Cost of Maintaining Work Horses.
A. 456	Periodic Costs of Rearing Dairy Males.
A. 504	Breeding Guernsey Cattle.
A. 660	Serum Tests for Contagious Abortion.
A. 813	Feed Cost of Milk and Butterfat Production.
A. 916	Losses in Ensiling Various Crops.
A. 973	Grass Ensilage, Optimum Amount for Dairy Cattle.
A. 987	The Value of Kelp for Dairy Cattle.
A. 1028	(F. 10.9.1) Loose Housing vs. Standard Stall Stabling of Dairy Cattle.

Apiary

Ap. 7 & 8	Wintering in Bee Cellar.
Ap. 10	Wintering in Single Cases.
Ap. 21	Comparison of Different Sizes of Hives.
Ap. 28	The Study of Flows.
Ap. 34	Rearing Queens.
Ap. 49	Wintering in Double Brood Chambers.
Ap. 89	Supering for Extracted Honey.
Ap. 120	Bee Poisoning.

Field Husbandry

F. 1.1	Meteorological Records.
F. 4.2.3	Commercial Fertilizer Formula for Pastures.
F. 4.5.1	The Renovation of Unimproved Pastures on Various Soil Types by Means of Commercial Fertilizers and Weed Killers.
F. 4.6.1	Observations on Grassland Management.
F. 5.2.2	Crop Responses to Commercial Fertilizers on Different Soil Types
F. 5.4.5.1	Methods of Maintaining Organic Matter in the Soil.
F. 8.5.2	Chemicals for Weed Control (Part I). The Effect of Herbicides on Annual Weeds in Grain.
F. 8.5.5	Chemicals for Weed Control (Part XIV). The Effect of 2,4-D on Pasture Weeds.
F. 8.5.6	Chemicals for Weed Control (Part X). The Effect of 2,4-D on Varieties of Canning Peas.
F. 9.2.3	Production of Ensilage from Early-cut Grass.
F. 9.2.4	Methods of Making Silage with Grasses and Legume Mixtures.
F. 10.1.1.0	Farm and Garden Tractor Operating Costs and Utility.

Horticulture

Fruit Products

H. 873	Variety Canning Test of Fruits and Vegetables.
H. 922	Fruit and Vegetable Juice Investigations.
H. 922.3	Use of Ion Exchange in Fruit and Vegetable Processing.
H. 923	Utilization of Small-sized apples.
H. 942	Dehydration of Fruits and Vegetables.

Small Fruits

H. 13	Strawberry Breeding.
H. 21	Strawberries, Variety Experiment.
H. 424	Blueberries, Cultivation of.
H. 793	Bush Fruits, Variety Experiment.
H. 908	Blueberries, Breeding and Selection.
H. 909	Blueberries, Propagation of
H. 938	Culture of Cranberries.
H. 939	Breeding and Selection of Cranberries.
H. 945	Breeding and Selection of Elderberries.
H. 949	The Improvement of the Native Low-bush Blueberry.
H. 964	Strawberry Mulching Experiment.
H. 985	Variety Trial of Hops.

Storage

H. 838	Fruits and Vegetables, Storage Investigations.

Tree Fruits

H. 26, A.B.C	Orchard Fertilizer Experiments.
H. 331	Cultural Methods Beginning with a New-planted Orchard.
H. 331B	Cultural Methods Beginning with an Old Orchard.
H. 331C	Cultural Methods Stressing the use of Cheap Mulching Materials in Newly Planted Apple Orchards.
H. 755	Different Rates of 9-5-7.
H. 767	Best Time for Picking Fruit.
H. 810	Cider Varieties for Cider Production.
H. 815	Tree Fruit Variety Tests.
H. 827	Tree Fruit Breeding.
H. 836	Rootstock Experiment (East Malling Trees).
H. 836C	Stembuilding Experiments (Tully Orchard).
H. 837	Tree Fruits, Method of Soil Management.
H. 839	Apple Thinning with Chemical Sprays.
H. 840	Nut Variety Experiments.
H. 913	Grass Mixtures for Permanent Orchard Sod.
H. 941	Grafting and Frameworking Experiments.
H. 961	Seedling Rootstock Production.

Vegetables

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H. 108	Herbs, Cultural Experiments.
H. 431	Tomatoes, Pruning Experiments.
H. 795	Leguminous Vegetables, Variety Experiment.
H. 802	Perennial Vegetables, Variety Experiment.
H. 803	Root Vegetables, Variety Experiment.
H. 804	Leafy Vegetables, Variety Experiment.
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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. 965	National Potato Variety and Seedling Tests.

Poultry

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P. 62	Costs of Egg Production.
P. 235a	Mode of Inheritance of Shell Strength.
P. 235b	The Use of a Penetrometer in Measuring Egg Shell Quality.
P. 235c	Shell Quality in Relation to Interior Quality in co-operation with the N.S. Research Foundation.

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IS–El.42	Four-year Rotation.
IS–El.52	Five-year Rotation.
IS–El.71	Seven-year Rotation.
IS–02.03B	Chemical Fertilizer as a Supplement to Farm Manure. (Rate of Application).
IS–02.03C	Chemical Fertilizer as a Supplement to Farm Manure. (Practice Study).
IS–02.03C–3	Chemical Fertilizer as a Supplement to Farm Manure. (Practice Study).
IS–04.03	Improving Hygienic Conditions in Old Stables.
IS–04–08	Whitewashing and Painting of Farm Buildings.
IS–07.01	Testing Mixtures for Hay and Pasture.
IS–07.13	Adaptation of Grasses and Legumes to Varying Regional Conditions.
IS–08.02	Chemical Fertilizer for Pasture; Study of Formulae.
IS–08.06	Pasture Seeding and Management Studies.
IS–09.01	Introducing New Varieties of Corn in Suitable Districts.
IS–09.05	Club Root Studies in Turnips.
IS–09.06	Methods of Controlling Brown-Heart in Turnips.
IS–10.01	Growing Certified Seed Potatoes.
IS–10.03	Introducing Suitable Varieties of Potatoes.
IS–11.02	Stimulating Interest in the Development of the Farm Garden.
IS–11.03	Encouraging the Establishment of a Farm Orchard.
IS–11.17	Farm Home Beautification.
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IS–13.05	The Sale of Livestock.
IS–13.07	Swine Production.
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IS–17.03	Study of Farm Productivity and Progress.
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