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CONTENTS

This volume includes progress reports of the following Experimental Farms and Substations of the Canada Department of Agriculture:

CANADA
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS SERVICE

EXPERIMENTAL FARM
HARROW
ONTARIO

H. F. MURWIN, B.S.A., SUPERINTENDENT

PROGRESS REPORT
1947-1954

Harper Hybrid, fusarium-resistant melon on left. Purdue 44 melon on right is susceptible to and practically all killed by fusarium wilt.

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The Rt. Hon. James G. Gardiner, Minister of Agriculture,
Ottawa, Canada

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PROGRESS REPORT

Experimental Station, Harrow, Ontario

1947-54

INTRODUCTION

The Experimental Farm at Harrow was established in 1923 to serve southwestern Ontario, but tobacco investigations were initiated fourteen years earlier (in 1909), with the setting up of the Harrow Tobacco Station. In 1933 a specialized Tobacco Substation was established at Delhi to provide a suitable location for flue-cured tobacco investigations in the New Belt. All projects on flue-cured tobacco previously undertaken at Harrow were transferred to the Delhi Substation, with the exception of the fundamental breeding work. The last published Progress Report from the Delhi Substation covers the period 1946-1952. To meet the demands of the rapidly developing flue-cured tobacco industry in Ontario, the research facilities and staff at Delhi have been greatly increased during the past eight years.

The specialized Experimental Substation at Woodslee was established in 1946 to study soil and crop production problems on the heavy soils of southwestern Ontario. To further these studies on the clay soil at Woodslee and on the tobacco and vegetable soils at Harrow, a soils laboratory was established at Harrow in 1948. Both the facilities for research and the staff at Woodslee have been increased during recent years. The published Progress Report from the Woodslee Substation covers the period 1946-53.

In 1949 a Science Service Laboratory was provided for the divisions of Plant Pathology and Entomology, which had occupied part of the Harrow Farm office for ten years.

Situated in the extreme southwestern part of Ontario, the Harrow Farm is climatically suited for experimentation on a variety of crops especially those requiring long growing seasons. During the period covered by this report research at Harrow was expanded and intensified in the four specialized divisions of work, tobacco, forage crops, field husbandry, and horticulture, to meet the increasing demand for agricultural information in the highly specialized crop districts. Work in poultry husbandry and cereal crops was also expanded during this period. Work in animal husbandry was discontinued with the transfer of the Jersey herd from Harrow to the Experimental Farm at Lennoxville, Que., early in 1954.

New phases of work undertaken at Harrow include studies on improved curing methods and cultural practices in the production of thin, bright, low-nicotine, cigarette-type burley tobacco; supplementary irrigation for early potatoes, tobacco, and early tomatoes; soil fertility studies for early potatoes, corn, oats, and alfalfa on different soil types; tests with soil conditioners; peach rootstock studies; methods of thinning peaches; spraying to increase

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corn yields and control borers; soil-building studies with vegetable crops; and studies on greenhouse tomatoes and cucumbers; participation with other experimental farms in an extended breeding project with White Leghorns and a comparison of various broiler crosses. Among the additional facilities provided at Harrow during this period were a soils laboratory; two greenhouses for work on greenhouse tomatoes and cucumbers; grading and packing facilities for fruit and vegetable crops; three experimental curing barns for burley tobacco; a modern tobacco grading room; a temperature-controlled fireproof seed storage for breeding material; a series of sand point wells and irrigation equipment adapted for sprinkler irrigation studies.

This report covers only certain phases of the research at Harrow. Results of much of the work undertaken have been published either in the form of bulletins, technical papers, popular articles, or press releases. A further insight into the work in progress at Harrow can be obtained from the list of active projects at the end of this report. The last published Progress Report covered the period 1937-46.

SOUTHWESTERN ONTARIO CLIMATE

Southwestern Ontario is favored with a mild climate and a variety of productive soils. Essex County has the longest growing season of any area in Eastern Canada with an average frost-free period of 163 days at Harrow. The long seasons permit the growing of later maturing crops of corn, soybeans, and tobacco than in any other part of Canada. The winters at Harrow are mild as evidenced by the fact that the temperature never reached zero at any time during the years 1952, 1953 and 1954. Snowfall is also light. The average annual precipitation at Harrow is only 27·38 inches which is the lowest recorded on any Experimental Farm in Eastern Canada. This accounts for the extensive irrigation of many high value crops in this district. The early springs facilitate the production of a variety of early truck crops on the lght sandy soils. The climate is ideal for the large hot-house industry in the southern part of Essex County.

As a result of the favorable climate and productive soils, canning crops are grown more intensively in Essex and Kent counties than in any other part of Canada. These counties also lead in the production of husking corn, soybeans, winter wheat, and sugar beets; which are grown on those heavier soils less suited to the production of early vegetables, fruit, tobacco, and other special crops.

Daily meteorological records have been taken at Harrow since 1918. Data are included to give weather conditions on the Harrow Farm during each of the years covered by this report as compared with a 37-year average. Extreme temperatures are seldom experienced at Harrow. The humidity is relatively high in the Harrow district and precipitation is low but fairly well distributed as shown in Table 1. However, there is seldom a year without a drought period and normally there is a moisture deficiency of some eight inches during the growing season. The average total precipitation at Harrow during the period covered by this report was 30·42 inches which is 3 inches greater than the 37-year average shown in Table 2. With the exception of 1953, the total rainfall each year during the 8-year period was greater than the 37-year average. Precipitation during the years 1947 to 1951, inclusive, was above normal and fairly well distributed but the last three years of the period covered by this report were definitely dry ones. In 1952 the total precipitation was just average but rainfall was below average in June, July, and August. As the season started with a good reserve of soil moisture the best corn crop in years was harvested in Essex County. The year 1953 started with a low moisture reserve and rainfall during each month from April to November, inclusive, was below normal. Two severe drought periods occurred during the summer of 1953, one in July and the other during late August and early September. This was definitely the driest year since 1946. The growing season of 1954 (April to September, inclusive), was also dry with less than normal rainfall each month except August. The heavy snowfall and rains late in March replaced some of the soil moisture reserve that was lacking but light showers during half of the days in April seriously delayed planting of crops on some of the heavy soils. Yields of many late crops were materially reduced as a result of the unfavorable growing season in 1954.

During the dry seasons of 1952, 1953, and 1954 many new irrigation systems were installed to provide supplementary water for an increasing number of high value crops throughout the district. Since water requirements for supplementary irrigation greatly exceed the readily available water supplies, major irrigation projects are being considered to provide an adequate source of water to meet the needs of the highly specialized districts of southwestern Ontario.

A detailed record of the total hours of sunshine by months and years throughout the period of this report is given in Table 3. Hours of sunshine recorded for each year from 1947 to 1954, inclusive, with the exception of 1949, were less than the 37-year average. The hours of sunshine during 1949 were consistently high throughout the entire growing season with a total of 190 hours more than the 37-year average.

Maximum, minimum and mean temperatures by months for the eight-year period of this report are shown in Table 4. Not since December, 1951 did the temperature drop as low as zero. Mean temperatures for the winter months have also been higher than the 37-year average, since 1951. Table 5 presents information on the last spring frost, the first fall frost, the frost-free period, and the number of crop days for each year during the period 1947-1954.

Table 1.—Monthly and Annual Average Weather Data Indicating Temperatures, Precipitation, and Hours of Sunshine at the Experimental Farm, Harrow, Ontario 1918-1954 (37 years)

Month	Temperature F°			Precipitation Inches			Sunshine Hours Average
	Mean Maximum Average	Mean Minimum Average	Mean Average	Rain Average	Snow Average	Total* Average	
January	32·5	19·0	25·8	1·14	9·8	2·12	76·6
February	35·0	20·1	27·6	1·21	8·3	2·04	93·3
March	43·4	27·3	35·3	1·96	4·7	2·43	123·4
April	55·7	36·0	45·8	2·50	1·4	2·64	162·8
May	68·1	46·6	57·3	2·41	0·1	2·42	237·0
June	79·1	57·9	68·5	2·96	....	2·96	253·3
July	83·5	62·3	72·9	2·13	....	2·13	293·4
August	81·5	60·0	70·7	2·28	....	2·28	265·5
September	71·4	54·0	64·2	2·40	....	2·40	192·6
October	62·6	43·6	53·1	2·05	0·1	2·06	158·6
November	47·0	33·2	39·8	1·57	3·2	1·89	89·1
December	35·2	23·2	29·3	1·23	7·8	2·01	64·1
Annual Total or Mean	57·9	40·3	49·2	23·84	35·4	27·38	2,009·7

* 10 inches of snow = 1 inch of rain

Table 2.—Precipitation Records, Experimental Farm, Harrow, Ontario.

(Monthly and Annual Precipitation Records in Inches 1947–54, inclusive, with 37-Year Averages and Monthly Extremes for same Period)

(Inches)

Year		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total Annual Snowfall	Total Annual Rainfall	Total Annual Precipitation
1947		2·56	1·05	2·77	5·07	3·88	2·88	1·33	5·64	1·77	1·47	1·90	2·47	40·1	28·78	32·79
1948		1·25	2·43	3·40	3·34	3·97	4·36	1·67	3·02	2·01	1·64	3·97	1·85	23·3	30·58	32·91
1949		2·21	1·69	1·84	2·04	2·38	3·92	3·56	2·53	3·11	2·82	1·17	2·91	9·8	29·20	30·18
1950		5·47	3·89	3·03	4·05	1·34	3·02	2·17	3·08	1·21	2·87	3·91	2·85	54·5	31·44	36·89
1951		2·10	3·49	2·40	1·92	1·99	3·83	1·71	3·19	1·39	3·04	3·13	2·96	49·9	26·16	31·15
1952		3·36	2·04	2·21	3·18	2·90	1·19	1·79	1·91	2·75	·61	3·41	2·16	24·4	25·07	27·51
1953		2·68	·85	2·73	2·14	1·78	2·16	·87	2·17	1·71	·85	1·09	2·01	23·1	18·73	21·04
1954		1·84	3·17	4·34	2·38	1·19	1·75	1·62	3·15	1·49	6·35	1·75	1·87	54·4	25·46	30·90
37-yr. Average		2·12	2·01	2·43	2·64	2·42	2·96	2·13	2·28	2·40	2·06	1·89	2·01	35·4	23·84	27·38
Extremes for the	Low	·51	·62	·82	·47	·49	·70	·32	·33	·42	·02	·44	·40	9·8	10·27	13·03
	Year	1921	1934	1937	1946	1934	1933	1919	1930	1928	1944	1939	1919	1949	1930	1930
37-year period	High	5·47	5·25	5·15	5·07	6·06	6·71	4·92	5·99	7·13	6·35	3·97	3·82	68·8	37·13	39·08
	Year	1950	1938	1921	1947	1943	1937	1939	1921	1926	1954	1948	1923	1926	1937	1937

Table 3.—Monthly Hours of Sunshine at the Experimental Farm, Harrow, Ontario 1947–54 (8 years)

Year		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1947		59·0	80·4	110·4	102·6	168·0	242·5	241·3	258·4	233·5	198·6	57·3	43·9	1,795·9
1948		105·5	89·9	127·7	160·7	234·7	212·8	255·9	277·9	161·8	116·0	73·2	97·9	1,914·0
1949		69·5	99·9	136·5	197·8	268·1	292·2	278·1	281·2	213·7	198·8	71·3	93·2	2,200·3
1950		57·6	100·4	137·1	98·0	254·3	249·7	288·0	291·0	157·6	148·6	83·9	51·0	1,917·2
1951		60·9	74·9	102·7	103·3	246·7	207·5	271·3	258·1	211·7	173·7	96·8	81·1	1,893·7
1952		68·9	76·6	133·7	192·5	198·2	257·6	285·5	259·0	227·4	160·0	79·4	46·4	1,985·2
1953		44·3	82·6	66·2	122·2	192·9	243·3	282·7	310·1	239·0	206·8	111·1	79·6	1,930·8
1954		70·0	95·8	141·5	171·0	239·1	235·2	281·0	260·4	175·1	131·1	97·2	64·9	1,962·3
37-year average		76·6	93·3	123·4	162·8	237·0	253·3	293·4	265·5	192·6	158·6	89·1	64·1	2,009·7
Extremes for the 37-year period	Low	38·2	46·0	66·2	98·0	146·6	154·3	241·3	196·0	107·7	98·1	45·7	27·2	1,724·1
	Year	1941	1935	1953	1950	1943	1940	1947	1926	1926	1925	1944	1929	1940
	High	133·9	152·8	166·7	222·5	307·8	323·4	355·6	323·1	239·0	206·8	131·9	111·6	2,290·3
	Year	1918	1933	1925	1941	1934	1933	1930	1932	1953	1953	1938	1943	1949

Table 4.—Highest and Lowest Temperatures Recorded in each Month, along with Mean Monthly Temperatures, Experimental Farm, Harrow, Ontario. 1947-54

Year		January			February			March			April		
		High	Low	Mean	High	Low	Mean	High	Low	Mean	High	Low	Mean
1947		50	5	30·7	48	2	22·9	54	17	32·0	71	29	45·8
1948		39	−6	20·1	53	−8	25·4	63	−4	35·5	83	26	52·1
1949		52	7	31·6	54	7	31·3	70	13	36·2	72	23	46·7
1950		63	−2	32·1	48	−3	27·1	56	7	30·6	70	19	41·2
1951		56	−6	26·7	59	−6	26·6	65	15	35·7	82	27	44·8
1952		58	8	29·1	44	11	29·1	65	16	34·5	80	25	48·9
1953		52	6	30·4	50	8	31·4	60	14	37·7	70	27	43·7
1954		48	1	26·4	59	7	33·1	62	11	32·6	78	15	49·2
37-yr. average		......	......	25·8	......	......	27·6	......	......	35·3	......	......	45·8
Monthly extremes for the 37-year period	High	63	13	38·2	67	14	37·9	79	23	46·7	86	29	52·2
	Year	1950	1933	1932	1930	1927	1922	1921	1942	1945	1942	1947	1942
	Low	35	−14	13·0	32	−20	16·6	50	−5	29·5	64	9	40·4
	Year	1920	1927	1918	1920	1918	1936	1941	1943	1934	1933	1923	1926

Year		May			June			July			August		
		High	Low	Mean	High	Low	Mean	High	Low	Mean	High	Low	Mean
1947		80	31	56·2	91	42	66·8	93	50	71·9	97	14	77·2
1948		82	35	56·4	91	38	67·7	92	53	73·5	96	26	70·9
1949		90	33	60·9	92	36	72·9	96	54	76·1	95	45	72·0
1950		80	28	57·7	91	42	67·9	91	46	71·1	94	48	70·1
1951		88	36	59·9	91	42	67·3	91	50	72·7	93	46	69·3
1952		89	32	56·9	99	47	72·2	94	53	75·9	91	43	71·1
1953		84	39	59·2	96	49	70·9	94	48	72·9	99	50	72·6
1954		83	30	54·8	93	43	71·2	97	45	71·1	90	50	69·5
37-yr. Average		......	......	57·3	......	......	68·5	......	......	72·9	......	......	70·7
Monthly extremes for the 37-year period	High	92	39	63·0	99	49	74·5	105	56	78·7	104	54	77·2
	Year	1942	1953	1944	1952	1953	1933	1936	1921	1921	1918	1937	1947
	Low	72	25	50·5	82	35	62·9	88	42	69·2	86	41	65·1
	Year	1924	1923	1917	1928	1929	1928	1943	1922	1920	1939	1935	1927

Year		September			October			November			December		
		High	Low	Mean	High	Low	Mean	High	Low	Mean	High	Low	Mean
1947		90	32	66·6	82	28	61·1	58	9	38·8	49	7	28·6
1948		86	42	65·7	70	27	49·9	67	30	45·6	56	4	32·1
1949		84	37	59·9	85	27	57·7	69	11	39·8	55	12	32·7
1950		81	33	62·8	81	29	55·6	78	6	35·9	48	−4	23·8
1951		86	31	62·3	89	28	55·2	56	13	34·2	59	−3	28·5
1952		94	38	64·8	86	23	49·1	68	18	42·7	54	11	33·7
1953		98	38	65·0	82	30	55·5	66	24	43·4	58	9	33·4
1954		94	36	65·7	81	30	54·3	66	26	40·6	46	4	29·9
37-yr. average		......	......	64·2	......	......	53·1	......	......	39·8	......	......	29·3
Monthly extremes for the 37-year period	High	98	44	68·7	89	33	61·1	78	30	48·8	61	21	39·0
	Year	1953	1921	1931	1951	1946	1947	1950	1948	1931	1941	1931	1931
	Low	81	29	56·7	67	23	43·4	55	4	34·2	34	−8	23·1
	Year	1950	1942	1918	1925	1952	1925	1925	1929	1951	1919	1924	1919

Table 5.—Experimental Farm, Harrow, Ontario Frost Records

Frost: 32°F. or Lower; Killing Frost: 28°F. or Lower

Year	Last Frost in Spring		First Frost in Fall		Frost-free Period Days (above 32°F.)	Last Killing Frost in Spring		First Killing Frost in Fall		No. of Crop Days (above 28°F.)
	Date	Temp.	Date	Temp.		Date	Temp.	Date	Temp.	
		°F		°F			°F		°F	
1947	May 10	32	Sept. 26	32	139	Mar. 31	25	Oct. 1	28	184
1948	Apr. 17	30	Oct. 18	27	184	Apr. 10	26	Oct. 18	27	191
1949	Apr. 25	32	Oct. 27	27	185	Apr. 17	27	Oct. 27	27	193
1950	May 8	28	Oct. 26	29	171	May 8	28	Nov. 5	26	181
1951	Apr. 27	32	Sept. 29	31	155	Apr. 20	27	Oct. 29	28	192
1952	May 3	32	Oct. 3	31	153	Apr. 12	28	Oct. 18	28	189
1953	Apr. 21	27	Oct. 8	30	170	Apr. 21	27	Nov. 5	24	198
1954	May 8	30	Oct. 7	32	152	Apr. 9	26	Nov. 1	27	206
37-year average	May 5	....	Oct. 15	....	163	Apr. 19	....	Oct. 30	....	194
Shortest Crop Season	May 24 (1935)	32	Sept. 30	31	129	May 12 (1934)	28	Oct. 14	26	155
Longest Crop Season	Apr. 25 (1918)	28	Nov. 11	32	200	Mar. 13 (1945)	26	Nov. 4	26	236

Earliest and Latest Frost Dates (32°F. or lower)
1918–1954

Latest spring frost	May 25, 1925—30°F.
Earliest last spring frost	Apr. 16, 1937—29°F.
Earliest fall frost	Sept. 26, 1947—32°F.
Latest first fall frost	Nov. 15, 1946—32°F.

Earliest and Latest Killing Frost Dates (28°F. or lower)
1918–1954

Latest spring killing frost	May 12, 1938—28°F.
Earliest last killing spring frost	Mar. 13, 1945—26°F.
Earliest fall killing frost	Oct. 1, 1947—28°F.
Latest first killing fall frost	Nov. 23, 1918—27°F.

TOBACCO

R. J. HASLAM and W. A. SCOTT

Trends in Production

Within the past decade the New Belt (Norfolk district) has extended its perimeter in flue-cured tobacco growing to new areas thus giving this belt the dominant position in Ontario's tobacco production. In the Old Belt (Essex and Kent counties) a decline has taken place in both the area of burley and dark tobacco grown and the number of farmers participating, especially since 1945.

Several reasons may be given for the changing picture in the two belts. The large increase in the world consumption of cigarettes at the expense of all other tobacco products has naturally favored the production of flue-cured tobacco. This popular cigarette type has continued to expand in districts where light sandy soil farms have been available at reasonable prices and where climatic conditions appear favorable. With the development of the new tobacco belt and its extended areas there has been a general exodus of share-croppers from the Old Belt to the newer areas where they have since become established owners of tobacco farms.

Following this shift of tobacco growing, light soil in Essex County has become more and more occupied with the growing of other cash crops. As a result much of the light soil formerly considered prime flue-cured tobacco land is now being used for early vegetables, greenhouse crops, and tender fruits.

Changes in consumer demand have resulted in less and less burley and dark tobacco being grown. These two types formerly made up the bulk of tobacco production in the Old Belt. The future of burley production is likely to be in direct relationship to requirements for light burley grades usable in blended cigarettes.

Export requirements for heavy burley and dark tobacco have declined in recent years, with little prospect of an increase because of the decreasing world demand for heavy tobacco. Table 6 gives the acreage of tobacco by types in the Old Belt for the period 1947 to 1954.

Table 6.—Acreage of Tobacco by Types in the Old Tobacco Belt (1947-54)

Year	Type of Tobacco			Total Acreage
	Flue-cured	Burley	Dark	
1947	2,318	13,200	2,056	17,564
1948	1,310	10,706	1,885	13,901
1949	1,587	11,385	1,728	14,700
1950	2,117	4,652	1,545	8,314
1951	2,470	2,480	574	7,524
1952	1,992	1,406	839	4,247
1953	1,909	1,096	100	3,105
1954	2,277	3,122	692	6,091

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Breeding and Testing Tobacco Varieties

Breeding and testing new tobacco varieties and strains has been in progress for many years at Harrow. Breeding is undertaken with the three major types, namely, flue-cured, burley, and dark tobaccos. The major developments in tobacco breeding have concerned resistance to black root rot and brown root rot because the use of resistant strains is as yet the most economical means of controlling tobacco root rots under field conditions. In the over-all picture, the progressive nature of the tobacco industry and the changes in consumer preference for milder smoking tobaccos necessitate a constant search for the best varieties.

Figure 1.—Flue-cured tobacco breeding nursery for black root rot resistance. Left to right: Delcrest (resistant), White Mammoth (susceptible), Jadel (resistant).

Flue-cured Varieties

The breeding and testing program on flue-cured tobacco is carried on jointly with the Experimental Substation, Delhi. Original crosses made at Harrow are finally tested for yield and quality at the Substation where soil conditions are typical of the best flue-cured soil in southwestern Ontario. New lines arising from this program are described in the Delhi Substation Report 1946-52.

Burley Varieties

To meet the several manufacturing requirements, a range of varieties of burley is imperative. There has been a definite trend in recent years toward light-colored, thin-bodied burley used in the cigarette blends and mild pipe tobaccos. This trend has been recognized in the breeding and testing of new lines. Varieties developed at Harrow, new strains from the Tobacco Division, Ottawa, and promising varieties from the United States have been included in the testing program.

Resistance to Black Root Rot

Black root rot caused by the fungus *Thielaviopsis basicola* was a serious menace to burley production in Ontario until resistant varieties were developed. Practically all burley varieties in commercial use at present are resistant to black root rot. Susceptible varieties, such as Halley's Special, Judy's Pride, Kelley, Gay's Yellow, and Station Standup have been replaced by Harrow Velvet, Burley 1, Haronova, and Harmony. Green Briar, grown chiefly for

Table 7.—Average Relative Yields of Burley Varieties Following Alfalfa, Corn, Tobacco, Respectively, (1951-54) (pounds per acre)

Variety	Preceding Crop		
	Alfalfa	Corn	Tobacco
Ontario Lines (Cigarette type)			
Haronova	2,092	1,388	1,851
Ottawa 174	2,082	1,680	1,768
Harrow Velvet	1,968	752	1,956
Haronic	1,905	1,554	1,943
Ottawa 194	1,902	957	1,914
Briarvet	1,850	1,642	1,825
Ontario Lines (Export type)			
Harmony	2,193	829	1,657
Improved Briar	2,012	1,026	1,710
Green Briar	2,091	1,673	491
United States Lines			
Burley 1 (Greeneville, Tenn.)	2,395	1,888	2,376
*Kentucky 56 (Lexington, Ky.)	2,596	805	2,091
*Kentucky 57 " "	2,458	981	2,053
Kentucky 16 " "	2,387	828	1,381
Kentucky 24 " "	2,051	1,349	1,686
Kentucky 26 " "	2,005	948	1,580

*Tested in 1953 and 1954, only.

its heavy leaf grades for export, is the only susceptible variety grown to any extent. Harmony has replaced Kelley. A new resistant line, Improved Briar, resulting from a cross at Harrow between a Kentucky resistant line and Green Briar, is showing promise as an export type.

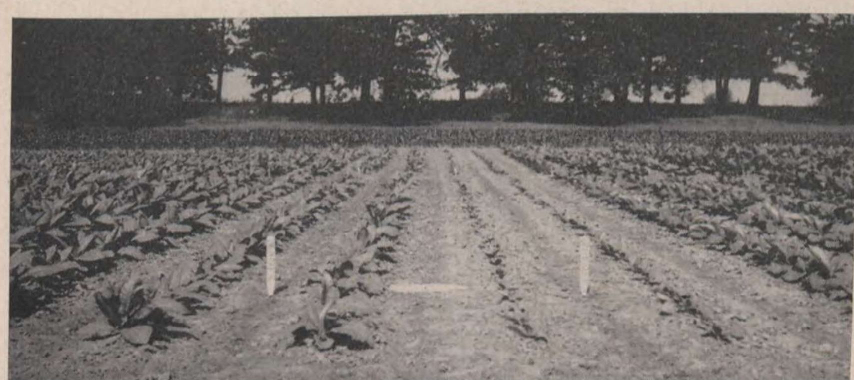

Figure 2.—Burley testing nursery for black root rot resistance. Left: Improved Briar (resistant); right: Green Briar (susceptible).

Resistance to Brown Root Rot

Brown root rot, a complex disease associated with crop effect and the presence of root rot nematodes, is chiefly confined to tobacco crops on sandy soils. Tobacco following corn, soybeans, or timothy sod may be stunted by brown root rot. Tobacco varieties are studied at Harrow in relation to resistance to brown root rot, using corn as the preceding crop in a corn-tobacco rotation. In this connection a resistance index for the principal varieties has been established and is presented in Table 8. Certain new varieties developed and tested at Harrow show a high resistance index against brown root rot.

Table 8.—Relative Root Rot Resistance Rating on Varieties and Strains of Burley Tobacco (1946-54)

Variety	Black Root Rot Resistance	Brown Root Rot Resistance
Harrow Velvet	Very high	Very low
Burley 1 (Tenn.)	Very high	High
Haronova	High	Medium
Harmony	Medium high	Very low
Haronic	High	High
Briarvet	Medium high	High
Ottawa 174	High	Medium high
Ottawa 194	High	Low
Green Briar	Very low	High
Improved Briar	Mediun high	Medium
Kentucky 16	Medium	Low
Kentucky 24	Medium high	Medium
Kentucky 26	Medium high	Low
Kentucky 56	High	Low
Kentucky 57	High	Low
*Burley 2 (Tenn.)	High	Low
*11-A "	High	Low
*11-B "	High	Low

*Tested in 1954, only.

Figure 3.—Testing new burley varieties for brown root rot resistance. Left: Burley 1 (resistant). Center: Kentucky 16 (susceptible). Right: Kentucky 24 (resistant).

The registered and thoroughly tested burley tobacco varieties are listed under the following descriptions:

Harrow Velvet—Selected at Harrow in 1930, released in 1931, as the first standup burley variety manifesting cigarette quality; highly resistant to black root rot; very susceptible to brown root rot. Moderate yielder of fine textured leaf. Early planting and high topping now recommended to produce the proper proportion of cigarette type leaf.

Haronova—	Intercross with Harrow Velvet and Station Standup; released in 1941; moderately erect type with broader leaf than Harrow Velvet; resistant to black root rot, moderately resistant to brown root rot. Above average yielder of fair quality cigarette type leaf. Early and close planting and high topping recommended.
Harmony—	Intercross with Harrow Velvet and Halley's Special; released in 1945; somewhat similar in growth characteristics to Haronova but possessing a heavier, slightly redder leaf. Resistant to black root rot; susceptible to brown root rot; high yielder, suitable for export leaf; medium wide planting and medium topping recommended.
Green Briar—	Re-selected at Harrow in 1949 from the original Kentucky Green Briar; drooping long leaf type; very susceptible to black root rot; resistant to brown root rot; medium narrow, heavy bodied, smooth textured leaves; excellent wrapper quality. Above average yielder on clean soil. June planting and low topping recommended.
Briarvet—	Intercross with Harrow Velvet and Green Briar; released in 1950; erect type, short internodes; narrow, pointed, fine textured leaves; moderate yielder. Excellent color, but low in lug grades for best quality smoking tobacco. High resistance to both black root rot and brown root rot. Early maturing; June planting, high topping recommended.
Burley 1—	Originating from Tobacco Experiment Station, Greeneville, Tennessee; first planted at Harrow 1951; semi-erect type. High resistance to both black root rot and brown root rot; similar in growth characteristics to Harrow Velvet, in possessing many leaves. Above average yielder of superior quality cigarette type leaf. Medium early maturing; May planting, high topping recommended.

Five of the registered burley varieties were compared in 1953 and 1954 as to number of leaves per plant, percentage of better smoking grades, and crop value per acre. These data are presented in Table 9 and clearly indicate that the two varieties Burley 1 and Harrow Velvet are best suited for the production of the new type of cigarette burley in demand at present.

Table 9.—Number of Harvestable Leaves, Percentage of Smoking Grades and Crop Index on Five Registered Burley Varieties (2-year average) 1953-54

Variety	Average Number Leaves	Smoking Grades	Crop Index
		%	
Burley 1	28·4	49·9	743
Harrow Velvet	28·7	40·2	632
Harmony	22·0	33·2	617
Haronova	21·0	18·6	500
Kentucky 16	21·9	13·8	623

Cultural Practices for Burley Tobacco

Since 1949 the production of burley tobacco has declined rapidly. Several factors were responsible for this reduction but all stem from the simple fact that tobacco products containing burley have gradually lost favor with the public.

Experiments at Harrow and in the district have shown that by the introduction of some rather radical changes in cultural practice, a new type of burley tobacco suitable for use in blend cigarettes can be grown in Essex and Kent counties. The suitability of this tobacco from the standpoint of its smoking qualities as determined by chemical and smoking tests remains to be proved after sufficient aging of the leaf now in storage. However, preliminary tests by cigarette manufacturers have been very promising in this respect, with the result that great emphasis is now being placed on these new cultural practices.

Briefly, the qualities required in burley cigarette tobacco are these: the leaf must be very thin and as bright in color as possible, in combination with a mild smoking flavor and a low level of nicotine. These qualities may be attained by closer planting and higher topping of particular burley varieties which embody rapid growth and thin leaf characteristics. The cultural experiments at Harrow in recent years have included treatments with much closer planting than generally adhered to in the district. The range of treatments now extends from 13-inch to 24-inch spacing between the plants in rows 40 inches apart. All distances of planting 21 inches or less have been satisfactory from the standpoint of producing thin leaf, but in the event of inadequate soil moisture during the growing season the yield and quality of tobacco may be severely affected by extremely close planting. Furthermore, the effectiveness of close planting may be governed to a great extent by the type and fertility of the soil. Taking all factors into consideration, 18-inch spacing is about the best in most cases. The second cultural practice of importance in producing thin mild tobacco involves a change to higher topping than customary in the past. In general, high topping consists of removing the whole flower and one or two top leaves when most of the plants are in bloom. This usually occurs about the end of the first week in August for crops planted early. However, the best height and time of topping may vary according to the variety. If any doubt exists it is preferable to top extra high in the first place and then, if necessary, top again, depending on the weather and the ensuing development of the crop. For example, topping extra high may result in immature tips that are poor in quality when cured and of little value. Nevertheless, they serve to reduce the body of the lower leaves during the development of the plant as maturity approaches. A second topping to remove such tips has the added advantage of reducing the actual length of the plants, making it easier to handle the tobacco during harvest, and it also prevents excessive overlapping of the tobacco between tiers in the curing barn.

Table 10 compares the results obtained from closer planting and higher topping of Harrow Velvet with the customary planting and topping practice.

Table 10.—Average Yields, Grade Indexes and Returns per acre from Two Cultural Practices with Harrow Velvet (1948-1952)

Cultural Practice	Yield	Grade Index	Returns
	lb.	c/lb.[1]	$
18 inch spacing high topping	2,425	37·1	882
24 inch spacing, medium topping	1,906	35·0	670

[1] c/lb.=cents per pound.

Close planting and high topping give greater yields owing to the increase in the number of plants per acre and the extra number of leaves per plant, in spite of the fact that individually the leaves are very thin and light. This means more work in planting, handling, and stripping but on the other hand suckering is reduced to a minimum by these cultural methods. Sometimes only one suckering is required just prior to harvesting, and as the suckers usually tend to grow mostly in the top of the plant they are very easily removed. If an earlier suckering is necessary the top sucker is left until harvest.

First attempts in the district to follow the new cultural practices indicate that they are most applicable on sand, sandy loam, and loam soils and not well adapted to clay loams. On the soils unsuited to the new cultural practices wider spacing and lower topping is still recommended to produce heavier bodied leaf for export requirements.

Fertilization

Fertilization experiments for the period covered by this report were confined to method and time of application. The introduction of efficient fertilizer attachments for tractor-mounted cultivators gave rise to this work. This equipment was developed for the specific purpose of fertilizing row crops during the growing season, which had hitherto been impractical. The application of fertilizer after planting provided several obvious advantages in tobacco growing. For example, it eliminated the necessity of a special operation to apply fertilizer ahead of planting time. Furthermore, the fertilizer was exposed to loss through leaching and fixation in the soil for a much shorter time prior to the period when the crop reached its greatest requirement for plant food. It remained to be shown what additional benefits, if any, might be obtained in yield and quality from delayed application of fertilizer for burley tobacco. A special fertilizer metering attachment was built for experiments in small plots and numerous combinations of times and methods of application were tried.

The fertilizer was applied in bands on each side of the row. This proved better than either drilling in the row or spreading and mixing the fertilizer throughout the soil. It was found that tobacco in the early stages of growth, after transplanting, did not require a large amount of commercial fertilizer. Consequently, it was unnecessary to apply all the fertilizer before or at planting time. In fact, if the fertilizer was not applied before planting the hazard of fertilizer burn on the young seedlings was eliminated. The application of fertilizer in bands at planting or after planting, about 4 inches or more from the plants depending on their size, prevented root burn entirely. The time, or times, at which to apply fertilizer after planting was not established exactly. Probably this is impossible because of the variation in weather conditions from season to season and the consequent difference in rate of growth at this time of year. However, several points were definitely indicated. Complete fertilization as late as five weeks after planting caused no discernible ill effects on burley tobacco in the field or delay in maturity. In general the best results followed when one-half of the fertilizer was applied at planting and the remainder two to three weeks later, depending on the growth of the crop.

A 5-10-15 fertilizer applied in bands at the rate of 1,000 pounds per acre in conjunction with 10 tons of barnyard manure in a crop rotation of alfalfa—burley tobacco—corn—oats has given excellent results on sandy loam soils at the Experimental Farm.

Curing Burley Tobacco

The trend toward thin, bright cigarette tobacco has emphasized more strongly than ever the need for a more controlled method of curing burley. Although the natural air-curing process is basically well suited to this type of tobacco, extremes or even normal variations in the weather often create unfavorable curing conditions in the barn.

Burley tobacco gives off moisture continuously while curing. If this moisture is removed from the barn either too rapidly or two slowly unsatisfactory curing results, and quality and yield may be adversely affected. For instance, high winds in dry weather may cause the tobacco to dry out too fast for optimum curing. This condition arises from time to time but it can be controlled usually by simply allowing less ventilation through the barn. On the other hand, extreme dampness, which is even more detrimental to curing, frequently occurs in the barn. This may be brought about by any one of a variety of weather conditions. It happens particularly in rainy or foggy weather but it often occurs even in fair weather. If there is insufficient wind during fair weather to cause good circulation through the barn, water vapor from the tobacco accumulates inside. A similar condition usually occurs at night when the rapidly falling temperature at sunset causes an increase in the relative humidity. The untimely accumulation of water vapor inside the barn for any or all of these reasons constitutes the main problem in the curing of burley tobacco.

If the excess water vapor could be removed from inside the barn at critical periods good curing would be more certain. One principle that appears practical is that of dehydrating the air in the barn at such times with calcium chloride. A specially designed dehydrator which was built and tested here, consistently increased the returns from tobacco for a very moderate expenditure of calcium chloride. Table 11 compares the yield and quality of tobacco from dehydrator-assisted curing with the yield and quality of tobacco from unassisted air-curing.

Table 11.—Yield per acre, Grade Value and Returns per acre for Burley Tobacco, cured with the aid of a Calcium Chloride Dehydrator compared with Unassisted Air-curing

Year	Method of curing	Yield per acre	Grade price	Returns per acre
		lb.	c/lb.	$
1948	$CaCl_2$ Dehydrator	2,063	36·0	740
	Unassisted air-curing	2,049	24·5	506
1949	$CaCl_2$ Dehydrator	1,786	31·2	606
	Unassisted air-curing	1,692	29·1	585
1950	$CaCl_2$ Dehydrator	1,916	41·0	785
	Unassisted air curing	1,789	35·6	638
1951	$CaCl_2$ Dehydrator	1,792	36·4	652
	Unassisted air-curing	1,741	33·1	578
1952	$CaCl_2$ Dehydrator	1,595	36·9	588
	Unassisted air-curing	1,526	35·4	540

The small curing compartments used in this preliminary experimentation had capacity for only about 1,000 pounds of green tobacco. To further test this principle of curing and also another method of curing using liquefied petroleum gas (propane) as compared with unassisted air-curing, three new curing barns were constructed in 1953. The capacity of these barns is approximately 8 tons of green tobacco. Curing methods may now be tested on a sufficiently large scale to determine their practicability for general use.

Figure 4.—New experimental burley tobacco curing barns. Left to right: Propane curing, calcium chloride curing, and natural air-curing.

Maturity Studies and Harvesting

Burley matures somewhat differently when grown for thin cigarette tobacco under the new cultural practices than when it is planted wider and topped down for heavier bodied leaf. Maturity in cigarette tobacco is denoted by a change in color from green to a distinct yellow. This change begins at the bottom of the plant about midseason. Optimum maturity is reached when the middle leaves of most of the plants have become yellow. At this stage under normal growing conditions the leaves immediately above the middle of the plant are pale green mottled with yellow and the top leaves may remain relatively green in color by contrast. From this it appears that a wide range of maturing rate exists from top to bottom of the plants. However, as the best quality tobacco for cigarettes comes from the lower half of the plant, the time of harvesting is governed more by the advent of maturity in this portion of the crop than by the appearance of the upper part of the plants. This does not mean that all the upper leaves will be very poor quality, because it has been shown that most of them usually cure quite well at this stage with the possible exception of the uppermost tip leaves in some cases. Optimum maturity is usually reached a little more than three weeks after topping.

If unfavorable weather causes premature 'firing' it may be necessary to harvest earlier to prevent loss of the lower leaves. This may mean sacrificing to some extent proper maturity and better quality in the leaves higher up the plant. Another alternative which has been tried here recently is to harvest the bottom leaves by priming when 'firing' appears imminent, thus making it possible to leave the remainder of the plant to be stalk cut when properly matured. If 'firing' continues a second priming may be necessary. In recent experiments at Harrow this procedure has been found very satisfactory in maintaining quality and preventing loss of yield. In fact yields were increased considerably over the average by following this practice. Table 12 presents the results of the priming experiments in 1952.

Table 12.—Comparing the effects of two Primings before Cutting with no Priming before Cutting, on the Average Yields, Grade Indexes and Returns per acre of Burley Tobacco (1952)

Method of Harvesting	Yield	Grade index	Returns
	lb.	c/lb.	$
Primed July 28 and Aug. 15, cut Aug. 25	2,328	31·7	739
No priming, cut Aug. 25	1,968	29·0	573

A different method of stalk cutting was tried here recently and appears to have considerable merit. Only one minor change in equipment is necessary for this operation; all the tobacco laths must be sharpened to a point at one end. In this method of harvesting the pointed end of the lath is jabbed firmly into the ground and each plant is speared onto the lath immediately it is cut. By following a prescribed pattern of cutting and handling this operation may be performed very efficiently. The tobacco is left to wilt on the standing stick until it is ready to be taken to the curing barn. This method causes much less bruising of the tender leaves, since it eliminates much of the handling required in the conventional method. In addition the tobacco is kept cleaner, particularly in case of rain, because most of the leaves are held well off the ground. Furthermore, the tobacco wilts under ideal conditions in this position and with much less danger from sunburn in hot weather if the laths are placed so that the butt ends of the plants are towards the sun.

Figure 5.—This burley crop was cut and strung on tobacco laths in one operation, and left to wilt in a standing position, as illustrated.

In practice trials, using men totally untrained for this major change in harvesting procedure, about the same amount of time was required to complete harvesting by this method as by the conventional method. In fact, there is reason to believe that, in addition to the other outstanding advantages, time could be saved by this harvesting practice, when sufficient experience is gained by the worker.

FORAGE CROPS

G. F. H. Buckley, C. W. Owen, C .G. Mortimore

Corn and soybeans are two of the principal crops grown in the district. The development and testing of new corn hybrids and soybean varieties at this Farm have helped to extend the corn and soybean acreage farther eastward. Some selection work is being carried on with sunflower but this crop is of minor importance at present.

In addition to plant breeding some studies are being made to determine the practicability of (*a*) spraying field corn with insecticides to control corn borer damage and (*b*) planting corn and soybeans in alternate rows or strips.

Corn

Corn is a leading crop in Essex and Kent counties and is rapidly gaining in importance in Lambton, Middlesex, and Elgin counties. In 1954 these five counties contained 60 per cent of the total corn acreage in Ontario and 83 per cent of the husking corn acreage. While the total corn acreage has increased by 75,000 acres since 1946 the husking corn acreage has increased by 160,000 acres. The provincial average yield of shelled corn has also increased from 43·3 bushels per acre to 54·8 bushels during the same period, a result of using better hybrids and better cropping practices. In the more favored areas yields of over 100 bushels of shelled corn per acre are not uncommon.

Breeding

Methods used to develop inbred lines and their combination into single and double crosses are similar to those employed elsewhere and were described in some detail in the 1937 to 1946 Progress Report from this Farm.

The newest development has been the incorporation of cytoplasmic male sterility into a number of the commonly used inbred lines. This male sterility, when possessed by the seed parent in the crossing field, eliminates the necessity of detasselling. Detasselling of the seed parent is one of the most costly and laborious procedures in hybrid seed production.

Breeding for resistance to disease and insect pests is receiving considerable attention. Root and stalk rot has been prevalent during the past few years. The organisms responsible for this rot cause a breakdown of the pith and consequent breakage of the stalk a short distance above the ground. An attempt is being made to develop inbred lines resistant to the disease. Resistance to corn borer attack is also being sought. Some selected lines now show much less corn borer damage than others, particularly with respect to the first-brood corn borers.

Testing

(*a*) *Ontario Hybrid Corn Tests.*—These tests are conducted under the direction of the Ontario Corn Committee and form the basis for recommendations advanced by that committee. They are located in areas that are representative of the major corn growing sections of the province and are open to all interested hybrid seed corn producers in Canada and the United States. The Forage Crop Staff of the Experimental Farm, Harrow, is responsible for sending out notices concerning the tests, receiving applications and entries, and distributing seed samples to the various testing areas. In addition the Farm is directly responsible for conducting the tests at Malden and Woodslee and co-operates with the Provincial Experimental Farm, Ridgetown, in conducting a test at that location as well as one in Elgin county.

As the larger hybrid corn producers now have a series of hybrids of satisfactory maturity range accepted by the Ontario Corn Committee, several of the companies have been using the Ontario tests for the past few years as a final testing ground for their experimental hybrids. If these are indicative of the type of hybrid being developed in the United States, then the hybrids of the near future will be shorter and stockier with the ears carried lower on the stalk. This type has certain advantages for mechanical picking.

From 1947 to 1954, based on tests at Malden and Woodslee, twenty-four hybrids were placed on the recommended list by the Ontario Corn Committee. Twenty of these originated in the United States and the others at Harrow.

(b) *Harrow Experimental Hybrids.*—New hybrids from the Farm's corn breeding program must be thoroughly tested to determine their value for commercial production. They must compete successfully with the best of the imported hybrids of the same maturity rating in yielding ability, sturdiness of stalk and root system as well as resistance to disease and insect pests. In order that the experimental hybrids may be compared on different soil types, the tests are placed at Harrow (sandy loam soil), Malden (Perth clay loam), and Woodslee (Brookston clay). In these tests some of the better imported hybrids are used as checks. Hybrids that prove outstanding after two years of testing are advanced to the Ontario Corn Tests. If successful there, they are recommended by the Corn Committee and licensed for production and sale in Canada.

During the eight years under review, four hybrids, Harvic 482, Harvic 485, Hesco 320, and Hesco 427 have been licensed. Harvic 482 and 485 are late maturing hybrids and are recommended for ensilage purposes throughout southern Ontario and for grain purposes only in the most favorable sections of Zone 1. Hesco 320 is an early maturing hybrid and suitable for grain in Zones 2 and 3. Its maturity rating is between those of the well-known Wisconsin hybrids 416 and 531. Hesco 427 is of medium maturity, being slightly earlier maturing than Wisconsin 606, and fits well into Zones 1 and 2 for grain purposes. At present four Harrow hybrids are in commercial production. Harvic 300, released in 1946, is now produced under the designation Pride K 300. Harvic 485, Hesco 427, and Hesco 320 are being produced as Warwick 800, 650, and 450 respectively.

Spraying for Corn Borer Control

The European corn borer has exacted its toll of the corn crop in Ontario for over twenty-five years. Until recently hot, dry weather during the egg laying period was the principal control of this pest. However, with the advent of such insecticides as DDT, control of the European corn borer became possible.

In 1950 a study was begun at this Farm to determine the effect of chemical control of the corn borer on the grain yields of field corn. The test included a number of hybrids which received one and two spray applications at various times during the egg laying period. In 1950 sprayed corn outyielded the unsprayed by as much as 8·9 bushels of shelled corn per acre. In 1951, a year of heavier corn borer infestation, average increases up to 17·1 bushels were recorded. On the other hand no significant increases were obtained through spraying in 1952, 1953, and 1954. Corn borer infestation was very low during these three years because the weather was hot and dry during the period when the first brood corn borer moths normally emerge and lay their eggs. Results of these tests definitely indicate that one properly timed spray will increase the yield of corn, by controlling the corn borer, equally as well as two sprays.

The data obtained suggests the following recommendations for spraying field corn for corn borer control:

1. It becomes profitable to spray when a count of egg masses shows approximately 100 masses on 100 plants
2. Apply a single spray 7 to 10 days after the count of egg masses has reached 50 masses per 100 plants. However, regardless of egg mass count, it is not necessary to spray when corn is less than 24 inches tall as measured from the ground to the tip of the longest leaf pulled upright.
3. DDT, Parathion, and Ryania are all satisfactory spray materials. At the present time DDT is possibly the best because it is both highly effective and relatively inexpensive. Apply at the rate of 1½ pounds of actual DDT per acre.
4. Use three nozzles per row to apply the spray, adjusting all nozzles so that most spray is put on the whorl and leaf axils.

Soybeans

Expansion and Present Status

During the period covered by this report the soybean crop in Ontario has grown in prominence at a rate seldom seen in crop expansions (see Table 13). The 1947 Ontario acreage of 61,000 gave a yield of 1,110,000 bushels valued at $3,397,000 while by 1954 the acreage had increased to 254,000 giving a yield of 4,953,000 bushels valued at $12,085,000. These figures are more impressive when it is realized that the average acreage for the previous 5-year period 1942-1946 was 47,678 acres. While the popularity of the soybean crop is increasing in other sections of the province, the main growing district is confined to five counties in the extreme southwestern part. These produce 95 per cent of the Ontario soybean crop. Acreage in Essex increased from 12,015 in 1947 to 85,000 in 1954 while during the same period the acreage in Kent increased from 19,903 to 73,200. The other counties included in the main soybean belt are Elgin, Middlesex, and Lambton.

Table 13.—Ontario Soybean Production

Year	Acres	*Yield per acre Bu.	Total Production Bu.	Price per bu.	Value
					$
1942	41,490	22·0	912,000	1·73	1,577,800
1947	61,000	18·2	1,110,000	3·06	3,397,000
1948	94,000	17·9	1,824,000	2·30	4,195,000
1949	103,800	25·1	2,606,000	2·26	5,890,000
1950	142,000	23·4	3,039,000	2·55	8,474,000
1951	155,000	24·8	3,873,000	2·75	10,651,000
1952	172,000	24·0	4,128,000	2·55	10,526,000
1953	216,000	20·4	4,406,000	2·31	10,178,000
1954	254,000	19·5	4,953,000	2·44	12,085,000

*Weather conditions are responsible to a large extent for the seasonal variation in yield. Dry weather in July and August and wet falls tend to reduce yields. In 1954, the yield was further reduced by a very wet fall.

Production of New Varieties

The soybean breeding program at Harrow is largely devoted to the production of improved varieties for Ontario. The variety characteristics sought include yielding ability, desirable plant type, disease resistance, and good seed qualities including satisfactory protein and high oil content. The aim is to develop soybeans with an oil content of 20 per cent or more. Improved early maturing varieties for those districts with a shorter growing season are sought in addition to the later maturing varieties for local use.

The variety Harman, released by this Farm in 1943, contributed largely to the early expansion of soybean growing. It is adapted to most of the main soybean growing districts and has been probably the most generally grown. It seems likely that the new Harosoy variety, released by this Farm in 1951, will become the most popular when sufficient seed stocks become available. Grower acceptance of this variety since its release has been outstanding both in Ontario and in several of the States in the United States soybean belt (Ohio, Indiana, Illinois, Missouri, and Nebraska). Since Harosoy matures a little earlier than Harman it is expected that it will be grown over a wider area of Ontario.

The two varieties lately released, Harosoy and Hardome, have the same parentage. However, Harosoy is the later maturing of the two and could be considered as a medium late variety adapted to growing in Essex, Kent, Elgin and the southern part of Lambton and Middlesex counties. For those parts of Essex and Kent counties with a longer growing season, Harosoy has been considered by growers to be sufficiently early for harvesting in time to plant fall wheat. Hardome was released in 1953. This is an early maturing variety that is expected to fill a need in the eastern part of the soybean growing district since it matures about two weeks earlier than Harosoy at Harrow. Seed supplies of Hardome were still very limited in 1954.

Hardome was awarded the World's Championship Seed Sample at the 1953 Royal Winter Fair. Harosoy won the Champion award at the Royal in 1951, and at Chicago in 1953. It won the Reserve Championship at Chicago in 1952 and at the Royal in 1953. In 1954 Harosoy was awarded the World Championship at the Royal and Reserve Award at Chicago.

Varietal resistance to soybean diseases has become an important factor in this district, particularly with respect to stem canker. While dry seasons reduce the damage, diseases are probably present and will cause losses when conditions favor their development. Surveys have shown that the Harrow varieties, Harman and Harosoy, possess greater resistance to stem canker than the imported varieties that have been grown.

Manganese Deficiency of Soybeans

During 1953 and 1954 the symptoms of manganese deficiency were widespread on the clay soils of this district. The condition is caused by a number of factors involving temperature, moisture, and soil acidity. The symptoms are a yellowing of the leaves between the veins while the veins themselves remain green. When this condition appears it is advisable to spray the plants with manganese sulphate at the rate of 8 to 10 pounds per acre as soon as possible. The amount of water required to prepare the spray solution will vary according to the type of sprayer used but should be sufficient to give good coverage of the plants. Reaction of the plants to this treatment should be evident in 4 to 5 days when normal green color will return. Generally an increase in yield can be expected from spraying to correct this condition.

Foundation Stock Seed

This Farm is also responsible for the maintenance of Foundation Stock seed of the varieties produced at Harrow. The five varieties being maintained at present are A.K. (Harrow), Harman, Harly, Harosoy, and Hardome. This provides stocks for Elite and Registered seed growers. In 1952 the estimated production of Registered soybean seed in Ontario was 40,373 bushels, of which the two varieties Harman and Harosoy accounted for 20,607 bushels or 51 per cent. In 1953 Harosoy and Harman accounted for 93·9 per cent of the total production of Registered seed.

Figure 6.—A multiplication field of registered Harosoy.

Rates of Seeding and Row Spacing

An experiment was conducted for three years to determine the influence of light, normal, and heavy seeding rates on yield and plant characters of soybeans when planted in 24- and 30-inch row spacings. Two varieties Harman and A.K. (Harrow) were used. Seeding rates for Harman were 30, 60, and 90 pounds per acre while for A.K. (Harrow), a smaller seed, the rates 25, 50, and 75 pounds per acre were used.

Little difference was found in yield between the different rates of seeding or width of rows, except with A.K. (Harrow) where the heaviest seeding rate showed a slight reduction. The greatest differences noted were plant survival in percentage of seed planted, and in lodging index. The percentage of plants harvested in relation to the number of seeds planted generally decreased as the seeding rate increased. At the same time the lodging index also increased as the rate of seeding increased, becoming more serious above the normal rate. The results of this test indicate that seeding rates above normal are wasteful of seed and may increase lodging to a critical point. No apparent gain in yield is obtained at seeding rates above the low rate, but under conditions of soil crusting the normal rate of one bushel per acre may be safer in obtaining an adequate stand of plants.

Alternate Planting

Another test covering a three-year period compared various combinations of alternately planted rows of corn and soybeans. In all cases the rows were spaced at distances normally used for corn. Combinations of 2 rows of corn to 1 row of soybeans, 2 rows of corn to 2 rows of soybeans, and 4 rows of corn to 2 rows of soybeans were compared. The alternate method of planting has the advantage of making each row of corn an "outside" row with the consequent improvement in yields. The tests gave a yield increase of about 9 bushels per acre of ear corn in both the 2-1 and 2-2 combinations. The 4-2 combination showed a gain of about 5 bushels of ear corn. Soybean yields were not unduly decreased except in the 2-1 combinations. Certain mechanical difficulties were encountered in harvesting.

Sunflower Breeding

A sunflower breeding program was initiated in 1945 in an attempt to improve a local strain. By inbreeding and selection several lines were obtained that appeared superior to the original material. These were allowed to intercross and selections were made in following generations.

In 1952 only one selection was maintained. It was planted out in a small multiplication block in 1953. Seed from this block was distributed to several sunflower growers for testing under field conditions in 1954. The tests were placed on the heavier soils in Essex County where the crop is best adapted. The results of these tests proved very favorable. In spite of the dry season yields of 1,400 to 1,800 pounds of seed were obtained per acre.

HORTICULTURE

T. B. Harrison and L. F. Ounsworth

The research program in horticulture is designed to assist those engaged in the growing of early vegetable crops and tender fruits. Foundation stocks of several vegetable varieties are being maintained and a comprehensive collection of peach and apricot varieties is under observation. In addition, the grounds of the farm have been beautified by the appropriate use of landscape material. This report covers some of the investigations undertaken on peaches, early tomatoes, and early melons.

Fruit

Peach Variety Evaluation

Peach orchards in southwestern Ontario have been planted mainly to heavy-producing, yellow-fleshed, freestone varieties acceptable to the basket trade, such as Redhaven, Golden Jubilee, Halehaven, and Elberta. Two of these varieties, Golden Jubilee and Elberta, are preferred by the commercial canner because of ease of peeling and pit removal but neither is sufficiently attractive for the modern basket trade. Redhaven sets an excellent standard in appearance and quality but is essentially a basket trade peach although suited to quick freezing. Halehaven can only be processed into baby food since it is difficult to peel and thus is sold mainly to the basket trade. If the commercial canning of peaches continues to increase there will be some interest in multi-purpose varieties suited not only to the basket trade but to processing as well. July Elberta and Valiant are useful midseason varieties of this type although highly susceptible to bacterial spot. Envoy, formerly known as N.J. 102, ripens with Golden Jubilee and should supplement that variety because of its undoubted superiority in appearance, flesh characteristics, and processing qualities including quick freezing. Most of the new varieties have been introduced for the basket trade and are not suited to commercial canning for various reasons such as excess pigment, clinginess, and difficulty in peeling. Some new varieties that may become important in one category or another are listed in order of ripening as follows: Dixired, Jerseyland, Envoy, Fairhaven, Triogem, July Elberta, Valiant, Southland, Summercrest, Kalhaven, Redskin and Vesper. All these varieties are self-fertile, yellow fleshed, and have produced satisfactory yields of fruit in recent years at Harrow.

Some of the above varieties may supplement, but it is doubtful if they will replace in this district, the established varieties such as Redhaven, Golden Jubilee, Early Elberta, and Elberta. The slightest tendency to cling cannot be justified in varieties ripening later than Redhaven so it is doubtful if Fairhaven and Triogem will be planted extensively. A useful list of varieties for this district should therefore include: Redhaven, Envoy, Valiant or July Elberta, Halehaven, Kalhaven, Early Elberta, or Elberta.

Bacterial Spot Susceptibiliy of Peaches

During the period 1935 to 1948 the occurrence of bacterial spot (*Xanthomonas pruni* (EFS)) of peaches in southwestern Ontario aroused little attention. The occasional defoliation of some varieties was generally attributed to arsenical injury and varied greatly in severity from year to year. In 1950, however, the disease became firmly established in the variety orchard at Harrow where marked varietal differences were readily apparent. The degree of infection has varied, reaching a peak in 1952 (Table 14) but was almost non-existent in 1953 and 1954.

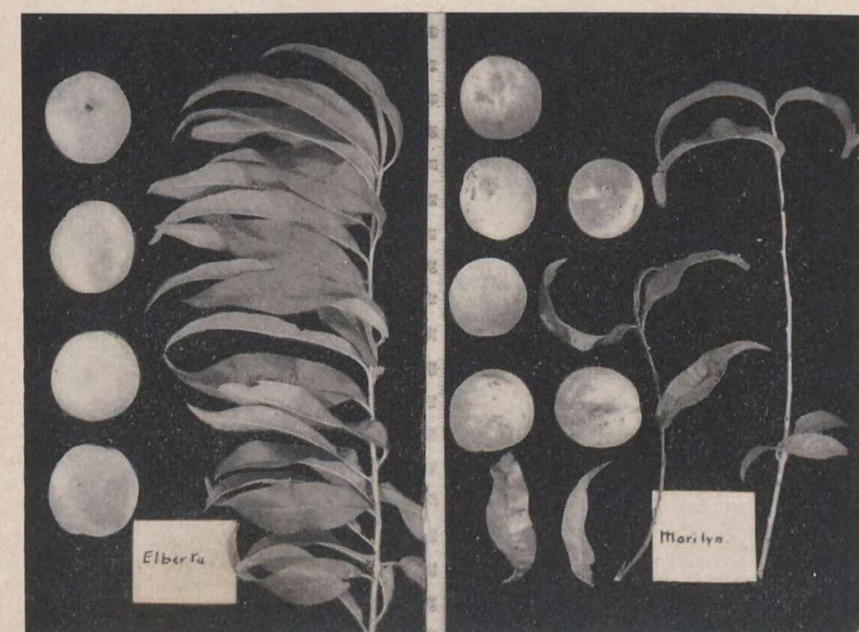

Figure 7.—On left, foliage and fruit of Elberta variety showing resistance to bacterial spot in 1952 as compared with Marilyn which is highly susceptible.

Efforts to control the disease with sodium nitrate sprays and fall copper sulphate sprays have not met with success thus focusing attention on the matter of varietal susceptibility. The disease has a weakening effect on the tree and may render the fruit of some varieties unmarketable. Control of this disease by means of antibiotics is currently under investigation at Harrow.

Table 14.—Bacterial Spot Susceptibility of Some Peach Varieties at Harrow 1951-1952

Severe	Moderate	Slight	Very slight	Nil
Blood Bonnie July Elberta Marilyn Sullivan Valiant Victory Vesper	Fairhaven Fireglow Geddes Golden East Jerseyland Prairie Clipper Redhaven Sungold Sunhigh Stark's Delicious Veefreeze	J. H. Hale Halehaven Kalhaven Southland Vanguard	Dixired Dixigem Elberta Envoy Newday Prairie Dawn Prairie Sunrise Sunday Elberta Somervee Summercrest Triogem Veteran	Ambergem Buttercup Erli-Red-Fre Golden Jubilee July Queen Marigold Redskin South Haven Stark's Early Elb. Sunbeam Vedette

Fortunately the four most heavily planted varieties, Elberta, Golden Jubilee, Redhaven, and Halehaven are not too seriously affected by the disease, with the possible exception of Redhaven in some seasons. Many promising new varieties and numbered selections (not included in the table) are moderately susceptible. A variety that can be affected by bacterial spot is not arbitrarily removed from the recommended list but it is doubtful if varieties in the severe category should be planted extensively in southwestern Ontario.

Peach Rootstocks

Several young peach orchards on high sandy ground were seriously injured following the winter of 1947-1948, which was continuously cold resulting in low soil temperatures particularly where the orchard cover had been removed by fall cultivation. The variation in root and stem injury from tree to tree was high and may have been the result of natural seedling variation in the rootstocks grown from local canning pits at that time. A red leaved selection of the Carolina Natural seedling rootstock known as Rutger's Red Leaf is now becoming available for nursery purposes and has been compared with other seedling rootstocks at Delhi and Harrow from 1951 to 1953.

Figure 8.—The distinguished red foliage of Rutgers red leaf is evident on the dark seedling shoots below as compared with the light color of the inserted buds above.

Elberta trees budded to six different seedling rootstocks were planted on sandy soil at Delhi in the spring of 1951 (Table 15) and during the following winter were subjected to below zero temperatures in November and December.

Table 15.—The performance of Elberta trees on various seedling rootstocks at Delhi, 1951-1952

Rootstock	% Growth rate	% Rootstock survival
Banner	158	25
Elberta	170	15
Gold Drop	219	25
Kalamazoo	164	15
Lemon Free	177	20
Rutger's Red Leaf	188	40

Winter 1951-1952, Nov. 6—2°F., Dec. 19,—10°F., Feb. 14, 1°F.

An examination of the trees in March 1952 disclosed winter injury on the above-ground portions and a final count was made in October on root and trunk survival. Seedlings of Rutger's Red Leaf appeared to withstand the winter better than other rootstocks with 40 per cent of the trees surviving. Growth rate figures show that trees on this rootstock made excellent growth. The characteristic red foliage of the Rutger's trees was helpful in distinguishing the rootstock from the budded variety and would function in a similar manner in the nursery.

Fall Mounding of Peach Trees Not Recommended

It has been the general impression among peach growers that a high mound of soil, i.e., more than six inches deep, would protect the tree against severe drops in temperature and act as a shield against injury by mice and rabbits. It is doubtful if mounding actually serves any useful purpose other than as required for borer control, in which case a two-inch mound will suffice.

Observations made in southwestern Ontario during the past seven years indicate that mounding has caused serious injury and some mortality in young peach orchards. The mound of soil tends to form into a hollow cone because of the whipping action of the young tree. Water will collect in this area and on freezing may exert pressure against the mound and the tree. In some years, notably 1948 and 1952, this ice pressure was sufficiently great under the above conditions to crush or raise the bark partly or all around the trunk thus causing serious mechanical injury. If borer control is necessary in young peach orchards during the first and second years it might be better to apply DDT in midsummer as recommended for this purpose and avoid the risk of causing damage by mounding.

A Search for Better Rootstocks for the Peach

Recent instances of damage to peach tree roots by low temperatures, root aphids, nematodes and possibly root rots or toxic substances have necessitated an evaluation of the rootstocks in present commercial usage. Lovell, obtained from the drying yards of California, has replaced Carolina Natural and Elberta seedlings as a rootstock for peaches because of its availability. In the search for superior rootstocks some preliminary observations show that Yunnan and Shalil seedlings produce budded trees of normal vigor under new orchard conditions and may produce superior trees under the adverse conditions sometimes associated with replanting.

Apricot has been under test as a peach rootstock since 1948 because the black peach aphid did not appear to attack the roots. It was found extremely difficult to bud in the nursery and also difficult to establish in the orchard because of its poor root system. Although many excellent trees are now growing in district orchards the occasional instance of breakage at the bud union has caused it to be discarded.

Efforts have been made to propagate present peach rootstocks from cuttings but only limited success has been achieved and mainly under greenhouse conditions. More recently heel-type cuttings obtained in June from a single Rutger's Red Leaf tree growing under orchard conditions have been placed under continuous mist. The cuttings remained viable for a long period but were difficult to establish even though the cuttings rooted under the constant mist.

Reduction of Peach Thinning Costs

Chemical Methods—The ideal thinning chemical should function when applied after crop prospects can be gauged. Tests with Goodrite p.e.p.s. plus Zimate applied after bloom in 1948 and 1949 were not promising and some injury was observed. Maleic hydrazide was tested in 1953 and functioned as a thinning agent but resulted in much reduced yields without any compensating increase in the size of fruit. Naphthaleneacetic acid sprays at 24 p.p.m. concentration applied to Elberta trees two weeks after shuck fall achieved satisfactory thinning without causing injury. This was not true of Redhaven, Golden Jubilee, and Halehaven trees which suffered some injury.

"Dinitro" methods of thinning peaches in bloom have been under investigation since 1947. Concentrations of Elgetol recommended widely for thinning, range between 0·125 per cent and 0·25 per cent by volume in water. Such concentrations would have been effective in only two years out of the last seven years in southwestern Ontario and yet caused severe injury in 1948. Some useful information has been obtained regarding the effect of the rate of drying and air temperature on the toxicity of "dinitro" sprays, which may facilitate their use. Since 1951 even 1·00 per cent concentrations of Elgetol were only partially effective in reducing fruit set because weather conditions were not only favorable for rapid drying of the spray but were also conducive to heavy fruit set.

More recently Chloro I.P.C. has been applied between three and four weeks after bloom with very promising results on Redhaven at 200 p.p.m. concentration but with excessive thinning on Elberta, Golden Jubilee, and Rochester at even 100 p.p.m. concentration. No damage to peach foliage and shoot growth was noted in 1954 even at 400 p.p.m. concentration.

Mechanical Methods—Tests have been conducted on club thinning since 1949 and have shown that the operation can be completed in less than one-fifth of the time required for hand thinning. A check on the average size of fruits removed by club thinning from established Elberta trees from 1951 to 1953 indicates that the fruits were no larger than those removed by hand. It was found that too few rather than too many fruits were removed at first, a situation that can be speedily rectified by giving a supplementary hand thinning or a

Figure 9.—Left: Blossom thinning with a bundle of dogwood shoots is an effective way to reduce fruit set in peaches. Right: A club made with a hoe handle and 18 inches of rubber steam hose being used to remove excess peaches in June.

second club thinning somewhat later. Only 3 per cent of the fruit from club-thinned trees in 1951 was below No. 1 grade at harvest. The fruit was examined for injuries that could be blamed on the use of the club but none were obvious at harvest time. Trees club-thinned for three successive years show no increase in bark or wood damage resulting from the club. The instrument found most generally useful consists of a hoe handle inserted for a distance of six inches into an eighteen-inch length of 1¼ inch, 3-ply rubber steam hose.

The more rapid and therefore earlier thinning possible with the club method is highly advantageous and has aroused interest in the possibilities of removing excess blossoms at full bloom by means of water pressure or switches. Water has been applied at 450 lb. pressure through a No. 12 disk but the large volume of water required, amounting to 40 gallons for an average sized tree, may render the method impracticable. Water thinning has been found particularly useful on high lightly pruned trees. Switch thinning involving the use of a dogwood branch or peach twigs is more laborious but is ideally suited to young rapidly growing trees. Both methods have resulted in a very striking response in fruit size since more than half the blossoms may be removed. These methods of blossom removal permit some degree of control and should be useful on heavy setting varieties such as Redhaven, Early Halehaven, Marigold, Valiant, and Kalhaven until replaced by a reliable chemical method.

Vegetables

The vegetable work at Harrow is centered around early fresh market tomatoes and early melons. In addition, studies for improving early vegetable soils, processing of foundation seed for a number of vegetables, National Potato Variety and Seedling Tests, and greenhouse variety tests of tomatoes and cucumbers are in progress.

Early Tomato Breeding Program

Since 1946 the tomato breeding program has involved 359 crosses, of which 237 have been discarded. Fourteen crosses were selected through six generations and then eight to ten selections of each of these crosses were included in a yield test to check on their yielding ability compared with standard varieties. Of these only one selection of each of two crosses was retained as having promise. One of these selections has since been dropped and the other (6-1205.1-7) has been named and released under the variety name Harrow.

Table 16.—Yields of Early Tomato Varieties for the years 1951 to 1954 compared with Bounty at 100 per cent

Variety	1951	1952	1953	1954	Average
Bounty	100·00	100·00	100·00	100·00	100·00
Monarch	157·5	112·8	115·2	189·4	143·7
Red Cloud	136·3	76·1	108·2	....	106·8
Red Chief	59·7	68·0	45·6	85·2	64·6
Harrow	159·0	97·0	98·2	139·0	123·3

The yields of five early tomato varieties are given in Table 16 for the years 1951 to 1954, with the Bounty yields set at 100 and the others calculated accordingly. Harrow, on the average, produced a better early crop than Bounty. In the year 1951, Harrow did very well with a yield of 159·0. In 1952 and 1953 the seasons were drier and Harrow did not show up so favorably since the fruits ran a little smaller than those of Bounty, a higher proportion being less than two inches in diameter. Harrow produced a good crop in 1954 which was another dry year.

The Monarch variety, in which the fruits are rather small, performed better than Bounty in all four years and Red Cloud was more productive in two of the three years tested. Red Chief, though of high quality, matures later and consequently does not compare with the other samples in early yields.

Figure 10.—The Harrow tomato variety (6-1205.1-7). Note the good crop of smooth fruits.

In the selection of Harrow, freedom from cracking was one of the chief points considered in addition to earliness and other characteristics. This freedom from cracking has resulted in a very high grade of fruit and showed up to advantage in the staking tests in 1953 and 1954. Most of the varieties in this têst developed three or four deep radial cracks on the shoulders of many fruits which automatically classed these fruits as culls. Most of the fruits of Harrow, on the other hand, were No. 1 grade.

Five staked tomato varieties are compared in Table 17. The yield of Harkness was set at 100 and the yields of the other varieties are given on a

Table 17.—Data on Some Staked Tomato Varieties, Average of 1953 and 1954

Variety	Early yield	No. 1 Grade	Weight per fruit
	lb.	%	lb.
Harkness	100·00	37·8	0·19
Harrow	183·3	59·7	0·21
Valnorth	87·0	39·8	0·22
Trellis Hybrid	78·7	23·8	0·19
Carleton	47·6	19·6	0·19

percentage basis. In these tests the variety Harrow produced nearly twice the yield obtained from Harkness. Valnorth and Trellis Hybrid produced less than Harkness and the early yield of Carleton was poor.

The freedom from cracking shown by Harrow is reflected in 59·7 per cent of its fruit being No. 1 grade compared with 37·8 for Harkness and 39·8 for Valnorth. The size of fruit for Harrow was fairly good when compared with the other varieties. Harrow is determinate in type of growth while the standard types for staking are indeterminate.

Figure 11.—Harrow on stakes. The fruits are free of cracking.

Two of the replicates in this test were topped at the third truss while the remaining two were permitted to produce four clusters. Four trusses definitely produced more marketable fruit before the market prices dropped than did the three clusters.

Melon Breeding Program

The melon breeding program was initiated in 1946 in an effort to produce a Fusarium wilt resistant muskmelon of high quality. Since that year 82 crosses have been made with most of them having one parent resistant to Fusarium wilt. A start has also been made to incorporate resistance to powdery mildew. Twenty-five of these crosses have been discarded for lack of resistance or lack of quality or both.

Since muskmelons must be hand-pollinated to ensure selfing of the fruit. there is a limit to the number of crosses or plants that can be handled in any one year. During the past several years, from 10,000 to 13,000 blossoms have been hand-pollinated each season.

Seventeen crosses have reached the sixth generation from which one to ten selections were made from each cross. These selections have been included in yield tests to determine their performance. Resistance to Fusarium wilt, quality, and yield are the main considerations. Six of these crosses are being retained for further testing.

Several melon hybrids resulting from the breeding program have appeared promising, but after testing for several years have all been discarded except one which has been named Harper. This hybrid has proved to be resistant to Fusarium wilt under conditions prevailing in the district and in the Fusarium-inoculated test plots. Harper produces a good yield of relatively early fruit, is a good shipper, and has high quality with excellent flavor. While this variety is subject to powdery mildew it seems to be able to hold up until most of the fruits have ripened. Harper rates above many varieties in this respect.

Table 18.—Yield and Size of Some Melon Varieties on Healthy Soil, Averages of the Period 1950 to 1954

Variety	Yield	Weight per fruit
		lb.
Perfection	100·0	4·39
Hoodoo	67·8	2·16
Honey Rock	52·5	2·49
Harper (hybrid)	104·3	3·59
Iroquois	74·3	3·89

Table 18 shows that Harper yielded as well as Perfection and above the other varieties on healthy soil. Perfection was one of the standard varieties in the district before Fusarium wilt became common. Iroquois, a resistant variety, does not have the yielding ability of Perfection or Harper, nor does

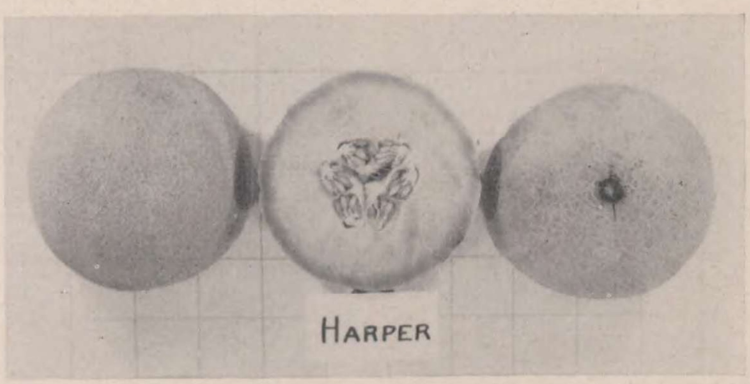

Figure 12.—The Harper hybrid shows little evidence of ribbing, has a good covering of fine net, is thick-fleshed and edible to the rind. The fruits average 3½ pounds. Background is laid off in two-inch squares.

it have the quality. The Harper hybrid has outyielded all of the varieties listed in Table 18 on Fusarium infested soil. Hoodoo and Honey Rock are commonly grown but do not yield so well as Harper nor do they have the resistance shown by Harper. The varieties in this test were grown on soil that was free of the Fusarium wilt in all years but 1954.

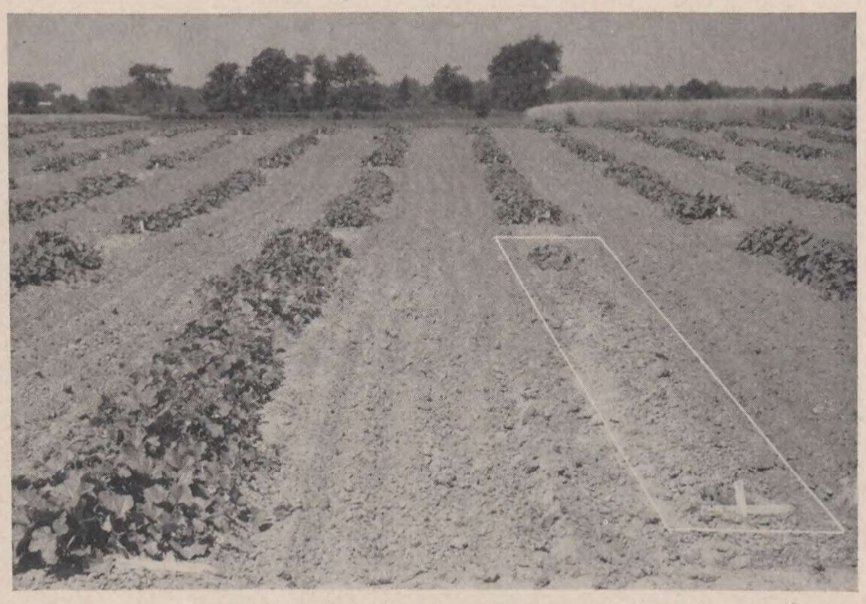

Figure 13.—Muskmelon variety test showing differences in resistance to Fusarium wilt in the foreground. Harper a resistant hybrid on the left and Honey Rock a susceptible variety on the right.

The Harper hybrid melon, produced at Harrow, has been tested by a number of growers in this and other areas during the past four years with gratifying results, both from the standpoint of a shipping melon and as a roadside market variety. Seed of the Harper hybrid was made available commercially in 1954.

FIELD HUSBANDRY

J. M. FULTON

Experimental work with fertilizers for early potatoes, corn, oats, and alfalfa has been in progress since 1947. Physical analyses have been conducted on soil samples from rotation experiments and a "soil conditioner" project was conducted at the Woodslee Substation on the Brookston clay. Since 1951 most of the soil physics projects have been conducted at the Woodslee Substation.

During the past five years there has been a marked increase in the use of sprinkler irrigation for the production of fruit and vegetable crops on the light-textured soils of this district. In 1953 three irrigation projects were established on the Harrow Farm.

Potato Fertilizer Experiments

The experiments with fertilizer formulæ were conducted in three successive years and it was not possible to show that any one of the formulæ used was superior to any other for early potatoes. Although the 4-8-10 fertilizer did not produce significantly more potatoes than the other fertilizers tested it was consistently near the top of the list. From these results it would seem that no change from the standard practice of using 4-8-10 fertilizer is necessary. (The 4-8-10 formula has been replaced by 5-10-13 which contains the same proportions of nitrogen, phosphorous, and potash but is more concentrated so equivalent quantities of the nutrients are supplied by ⅘ of the amount of fertilizer.) In these experiments there was a definite trend toward higher production where 1,200 pounds of 4-8-10 per acre was applied than where 800 pounds per acre was used.

An experiment has been conducted for five successive years on the effect of splitting the fertilizer application between planting time and side-dressing and the effect of applying additional nitrogen as a side-dressing.

The average yields of potatoes for the three treatments over the five-year period are shown in Table 19.

Table 19.—Average Potato Yields in Bushels per acre 1948-52

Year	Treatments		
	1,000 lb. 4-8-10 at planting	1,000 lb. 4-8-10 at planting plus 100 lb. of NH_4NO_3 side-dressed	500 lb. 4-8-10 at planting plus 500 lb. side-dressed
1948	144·5	201·2	176·2
1949	257·4	218·3	218·6
1950	216·5	179·9	206·9
1951	334·6	303·7	328·6
1952*	44·3	47·4	33·4
Average	199·4	190·1	192·7

* Low yields in 1952 result from extreme drought in early season

Total potato yields over the five-year period show that there is a slight advantage in applying all the fertilizer at planting time.

Weather records indicate that the amount and intensity of rainfall between planting time and when the plants are 6 inches high influences the response to side-dressing treatments. In 1948 when the ammonium nitrate side-dressing in addition to 1,000 pounds of 4-8-10 at planting time gave best results 3·15 inches of rain fell between May 6 and May 10. In contrast to this the rainfall during the first three weeks in May 1949 was well distributed with 2·34 inches falling between May 1 and May 21. In addition there was no rainfall during the two-week period following side-dressing in 1949. This lack of rainfall might prevent the efficient use of the side-dressed fertilizer. The low yields in 1952 are a result of extreme drought in June and July which resulted in few potatoes reaching marketable size.

During 1953 and 1954 experiments were conducted on three soil types, in an attempt to determine the best rate of fertilizing potatoes on these soils. Results show that a rate of 800 pounds per acre is just as effective as higher rates up to 3,200 pounds per acre. This held true on both irrigated and non-irrigated areas and on all three soil types.

Corn Fertilizer Experiments

The fertilizer experiments with corn were first established in 1948 using a number of fertilizer formulæ at rates of 200 and 400 pounds per acre. Little information was gained from these experiments and consequently the work was expanded in 1951 to include four levels of nitrogen, 0, 33, 66, and 132 pounds per acre, two levels of phosphate 0, and 80 pounds of P_2O_5 per acre and two levels of potash 0 and 60 pounds of K_2O per acre. Results to date have indicated that corn grown on the heavy soils of this district responds very little to phosphate and potash. These experiments and others conducted co-operatively with the Woodslee Substation show that applications of nitrogen to Brookston clay soil at the rate of 66 pounds per acre will increase corn yields more than 20 bushels per acre where the crop follows a non-legume. The 1952 data show that the amount of the response is dependent upon the number of plants grown per acre. A population of 9,000 plants per acre responded little to nitrogen applications, but with 12,000 plants per acre and an application of 200 pounds of ammonium nitrate yield was increased by 20 bushels per acre.

Residual Effects of Fertilizer Applied to Corn

There was a striking residual effect of corn fertilizers on the following oat crop. On plots where no nitrogen was applied to the corn in 1952 the oat yields in 1953 averaged 61·1 bushels per acre. Where 33, 66, and 132 pounds of actual nitrogen was applied to the corn crop in 1952 the oat yields the following year were 71·7, 82·6, and 86·4 bushels per acre, respectively. Where the oats followed corn in the rotation the increased oat yields alone more than paid the cost of 66 pounds of nitrogen applied to the corn and as shown above when the corn followed a non-legume crop the application of 66 pounds of nitrogen increased corn yields by more than 20 bushels per acre.

The phosphate and potash fertilizer applied to the corn had no residual effect on the oat crop.

Potato Irrigation Experiments

Experiments dealing with the irrigation of early potatoes were started at Harrow in the spring of 1953. These experiments were designed to obtain basic scientific data applicable to problems confronting irrigation farmers in this district. All of the work in 1953 was confined to the irrigation of early potatoes grown on the Fox sandy loam at Harrow. Investigations were concerned with: (*a*) the proper level at which available soil moisture should be maintained, which involves the time intervals between irrigation applications; amount of water to apply per irrigation, and the depth from which the crop obtains its water supply, (*b*) stages of crop development at which supplies are most critical, (*c*) rate of application and (*d*) rate of fertilization in relation to irrigation practices.

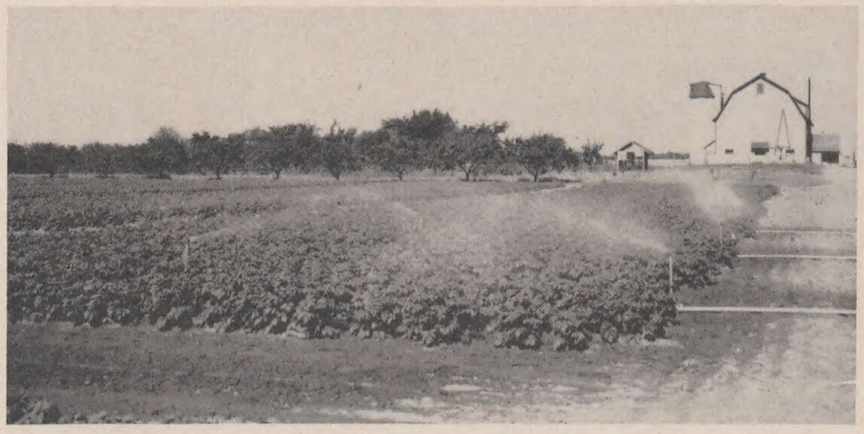

Figure 14—Irrigated potato plots at Harrow.

Available Moisture Levels

The highest potato yields were recorded where the available soil moisture supply in the top 6 inches was maintained at 75 per cent of full capacity. Maintenance of the available soil moisture at this level demanded frequent light applications of water with a corresponding increase in the cost of labor for moving the pipes. Since the cost of each application is fairly constant the price and yield of marketable produce will determine whether it is economical to maintain the available moisture supply at this high level.

Table 20.—The Response of Early Potatoes to Higher Levels of Available Moisture

Irrigation Treatments	Yield in bushels per Acre	
	1953	1954
At 75 per cent available moisture*	278·3	239·4
At 50 per cent available moisture*	268·4	212·6
At 25 per cent available moisture*	230·2	162·5
No irrigation	140·8	93·5

*Irrigation water was applied when the soil moisture was reduced to 75, 50, and 25 per cent, respectively, 6 inches below the soil surface.

Irrigating to maintain the available moisture supply at 50 per cent of the water capacity of the soil produced an average of 44 bushels per acre more marketable potatoes than irrigation to maintain the available water at the 25 per cent level and 18 bushels less than that at the 75 per cent level. The total amount of water used was almost identical for the 25, 50 and 75 per cent levels, however the number of applications involved were 3, 5, and 6, respectively. The value of produce irrigated at the 50 per cent level was sufficiently greater than that produced under irrigation at the 25 per cent level to warrant following such an irrigation program for early potatoes.

Non-irrigated plots, of course, produced only slightly more than one-half the quantity of marketable potatoes grown on the lowest yielding irrigated plot under the 1953 and 1954 weather conditions at Harrow and a little more than one-third as much as the best irrigation plot.

Irrigation at Different Stages of Growth

From initial results obtained in 1953 the time to start irrigation of early potatoes depends almost entirely upon the amount of moisture in the top 6 inches of soil. Each day, delay in applying water after the available soil supply was exhausted reduced the yield. Weather conditions at Harrow are such that available soil moisture will seldom fall below 25 per cent until after the crop has reached the stage of first tuber formation (6 to 8 inches in height).

When irrigation was delayed until 50 per cent of the plants showed bloom the number of irrigation applications was reduced from three to two with a corresponding reduction in yield of 28 bushels per acre. However, even this reduced yield was approximately 50 per cent greater than non-irrigated yields.

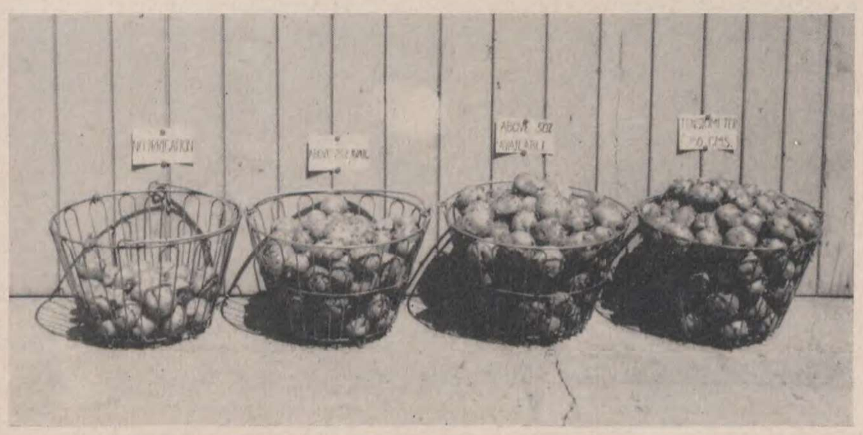

Figure 15—Relative yields of marketable potatoes under various irrigation treatments. (Tensiometer 700 cms. corresponds to 75 per cent available soil moisture.)

Rate of Application

The rates of application tested in 1953 appeared to have little effect on the yield of potatoes. However, where the water was applied at the rate of three-quarters of an inch per hour the surface of the soil remained in a puddled condition for about three hours after the sprinklers were turned off. When the rate was reduced to one-third of an inch per hour the soil surface was firm within fifteen minutes of the time that irrigation ceased.

The Calendar and Rain Gauge as a Guide to Irrigation Practice

The 1953 irrigation experiments indicated that to maintain the available soil moisture supply above 50 per cent it was necessary to supply the area with one acre-inch of water about every seven days from about June 1 until the crop was harvested early in July. If this amount of water is not supplied by rainfall the difference should perhaps be made up through irrigation. A rather simple experiment was established in 1954 to test this theory.

Irrigation water was applied so that the total water received by the area amounted to (a) 1 inch every five days (b) 1 inch every seven days and (c) 1½ inches every ten days. One-half of each plot was fertilized with 800 pounds of 5-10-13 per acre and the remainder with 1,600 pounds of 5-10-13 per acre.

The most effective treatment was the one supplying 1 inch of water every seven days regardless of the rate of fertilization. When the water was applied at the rate of 1 inch every five days the fertilizer rate had to be increased from 800 to 1,600 pounds to maintain yields. It would appear that irrigating potatoes on a schedule of 1 inch every five days supplies an excess of water which must have resulted in loss of fertilizer through leaching.

An inch and one-half of water applied every ten days was not quite so effective as one inch every seven days indicating that the interval between irrigations was too long. The period of time allowed between applications will, of course, depend upon the moisture-holding capacity of the soil, and on heavy-textured and low-lying soils the proper irrigation interval may be considerably longer than seven days.

Soil Testing Service

The Harrow Farm provides soil testing service for the farmers of the district. Soil samples are brought or sent in by farmers and are subjected to the rapid soil test for available nitrogen, phosphorus, potassium, calcium, and acidity. Fertilizer recommendations for the specific crop to be grown are based on the results of the tests, the cropping history of the area, and the results from fertilizer and soil management experiments conducted at the Harrow Farm, the Woodslee Substation, and on soil types in the district.

A good example of the value of a knowledge of management practices and past cropping history is the case of making fertilizer recommendations for corn production on the heavy-textured soils. Experiments have shown that the economical use of fertilizer on these soils depends not only on the level of the available soil nutrients as indicated by analyses, but upon the number of plants grown per acre, the presence or absence of legumes in the rotation, and to some extent the quantity of manure used in the rotation.

The use of this service by farmers of the area has increased considerably since 1947 as shown in Table 21.

Table 21.—Farmers' Soil Samples Tested at Harrow 1948-54

Year	Number of farmers submitting samples	Number of samples tested
1948	175	500
1949	261	700
1950	278	697
1951	262	815
1952	450	1,224
1953	531	1,471
1954	596	1,768

CEREALS

C. G. MORTIMORE[1]

Winter Wheat Investigations

The testing of varieties and selections of winter wheat is continuing at Harrow in an expanded program. The work consists of breeding, selecting, and testing disease-resistant strains in co-operation with the Cereal Crops Division, Ottawa. In addition one of the regional winter wheat tests, sponsored by the Ontario Winter Wheat Committee, is conducted each year at Harrow in co-operation with the Ontario Agricultural College, Guelph.

The objectives in the winter wheat breeding and testing programs are to develop new, stiff strawed, high yielding varieties of both white and red winter wheat that are disease resistant and possess the desired quality for the soft wheat milling trade. Each year quality determinations are made on all varieties and strains under test. There is every indication that in the near future higher yielding Canadian varieties of winter wheat will be available for this area. During recent years several tested strains have given higher yields than the variety Cornell 595.

In recent years Cornell 595 has been the most popular variety of winter wheat due to its high yield and stiff straw. This variety has a white kernel and is a very soft wheat producing high quality pastry flour. It is resistant to loose smut but is moderately susceptible to rust.

Genessee, a more recent introduction, is gaining in popularity because of high yielding ability. In five years of testing at Harrow Genesee has outyielded Cornell 595 by an average of 2·6 bushels per acre as shown in Table 22. This variety shatters less than Cornell 595 but is not quite so stiff in the straw. The milling qualities and loose smut resistance of these two varieties are very similar.

At present, Fairfield is one of the best yielding red winter wheat varieties available. However, it yields considerably less than the best white kernelled varieties such as Cornell 595 and Genesee. Some of the new red kernelled strains are yielding much better than Fairfield so higher yielding varieties of red winter wheat, possessing desirable quality, may soon be available.

Table 22.—Average Yields of Winter Wheat Varieties Over a Five-Year Period (1950-54) at the Experimental Farm, Harrow, Ontario

Variety	Color of kernel	Yield per acre
		bu.
Genesee	White	61·1
Cornell 595	White	58·5
Fairfield	Red	55·9*

*Four-year average, 1950–53.

[1] Temporarily assigned cereal crops investigations following death of B. S. Hoegstedt.

Oat Variety Tests

In the search for better oat varieties for this area yield tests are conducted each year both on the Experimental Farm and in the district. These tests include promising strains developed at the Central Experimental Farm, Ottawa, and the Ontario Agricultural College, Guelph, as well as selections made at Harrow. Also included are any promising new varieties developed in the United States.

Results of oat tests conducted on three soil types in Essex County still show preference for early maturing varieties. The best varieties are listed in Table 23, with their average yields over the past five years on the different soil types.

Table 23.—Average Yields of Oat Varieties for Five-Year Period (1950-54) on Three Soil Types in Essex County

Variety	Average Yield per Acre		
	Sandy Loam	Perth Clay Loam	Brookston Clay
	bu.	bu.	bu.
Ajax	54·6	77·9	77·3
Beaver	56·9	77·2	75·5
Clinton	53·9	79·9	68·0

The five-year averages show little differences in yield between these three varieties on both sandy loam and Perth clay loam. On the other hand, over the five-year period Clinton yielded somewhat lower than Ajax and Beaver on the Brookston clay, a soil generally of lower productivity than the other two. However, Clinton possesses other features which have made it the most popular oat variety in Essex County. This variety has very short straw and seldom lodges which makes it ideal for combine harvesting as well as a nurse crop for clovers. All three varieties have good straw strength.

Simcoe, a new oat variety recently released by the Ontario Agricultural College, Guelph, has given yields comparable to the best variety on each of the three soil types in the few years that it has been included in the Essex County tests.

POULTRY

W. F. Mountain

Breeding for Egg Production

Since 1950 the work of the poultry division has followed a new pattern so far as it relates to breeding poultry for egg production. Previously, a highly efficient strain of Barred Plymouth Rocks had been maintained. Its record of production was of a very high standard, but the flock was too small to permit study of any breeding questions of present-day importance. This difficulty was overcome by co-operating with five other Experimental Farms in an extended breeding project with White Leghorns.

The actual breeding operations are conducted at the Central Experimental Farm at Ottawa and the stock is shipped as chicks to Experimental Farms situated from British Columbia in the West to Prince Edward Island in the East. Farms in Alberta and Manitoba are used to provide conditions associated with northern latitudes while the Harrow location is the most southerly in Canada. Several important phases of breeding poultry for egg production are included in the new project. A control strain has been developed at Ottawa and pullets from this strain are tested in the same pens with the progeny from pedigreed and selected lines.

Separating environmental factors from those with an hereditary basis is a complex problem, but the facilities of the Experimental Farms system are uniquely constituted for such investigations. One example is the recently completed experiment with samples of the Harrow Strain of Barred Rocks at three widely separated Farms. The results were interesting in that although the genotypes were the same in all groups and hatching time was simultaneous, there were distinct differences in the performances of the stock at each location. The fact that such important factors as survivor egg production, laying-house mortality, and body weight showed the influence of environment to a significant degree, strongly indicated that various strains of fowl may not be fairly compared except under the same environment. Such differences also direct attention to the manner in which environment may mask inherited characters.

Egg Yield of Daughters According to Performance of Dams.

The manner in which the egg production of daughter groups followed the performance of their dams is shown in Table 24. All the dams from which families have been tested during seven years' breeding work were grouped into 4 classes each differing by 25 eggs. The pullet family of each dam was put into a class according to its average production and then all were sorted out according to the yield of their respective dams.

Table 24.—Frequency of Families Occurring in Egg Production Classes According to the Standard of Dams

Dams Egg Production Range	Number of Families of Dams	Ranges of Egg Production of Daughter Groups									
		121–140	141–160	161–180	181–200	201–220	221–240	241–260	261–280	281–300	301–320
225–250	66	......	1	1	5	9	21	19	10	......	......
251–275	120	1	1	1	1	20	37	34	17	8	......
276–300	100	......	......	......	2	10	22	43	20	3	......
301–330	54	......	......	......	1	4	15	12	15	5	2

At the same time that the yield classification of pullet sister groups shows an indication of daughter-dam relationship a view of the data in a condensed form is possible in Table 25. Although the average of the highest daughter groups was 20 eggs above the lowest group average it was achieved by way of a 78-egg superiority of the high dams over the low dams. When dealing with high producing strains the difficulty in obtaining further increases is clearly illustrated in this analysis.

Table 25.—Average Egg Production of Daughter Groups Compared with Average of Dam's yields Separated in Classes at 25 Eggs

Dams Egg Production Range	Average Egg Production of Families According to Dams Yields	
	Dams	Daughter Groups
225–250	233	233
251–275	264	240
276–300	286	244
301–330	311	253

Hatching Egg Fertility According to Male-Female Ratio in Mass Mated Flocks

Since various conditions may interfere with fertilizing processes, the most economical number of males for maximum fertility is often in doubt. Theoretically, it is possible for a comparatively small male population to bring about good fertility but in practice greater numbers are generally necessary.

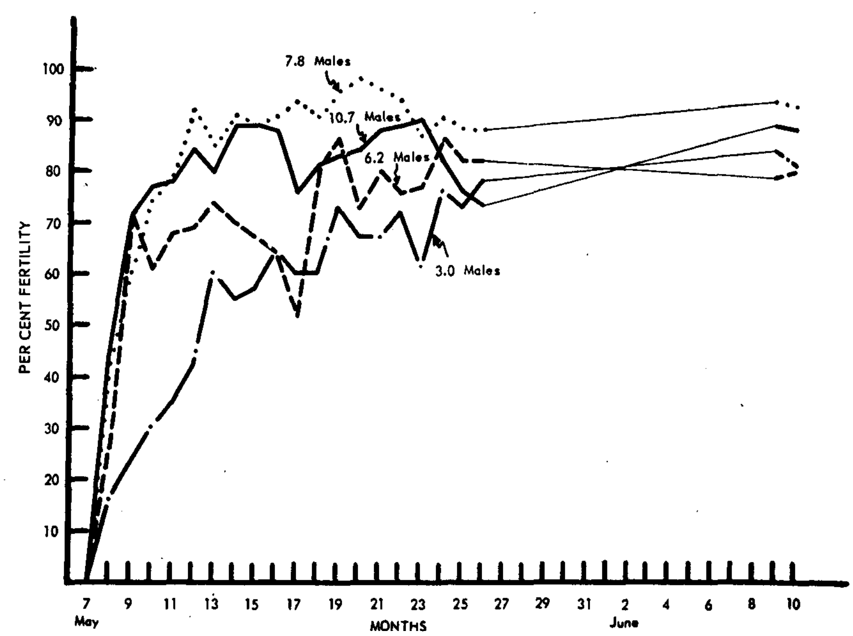

Figure 16.—Fertility of eggs as effected by various sized male groups among approximately 100 hens.

Since the maintenance of males for breeding purposes involves considerable expenditure of time and money, a series of experiments was conducted to investigate the effect of various sized male groups on fertility. The experiments extended over two seasons and covered seven separate tests in which twenty-eight pens of birds were used. Each pen held approximately 100 hens with 2, 4, 6, 8, or 10 males. The results showed that the higher levels of fertility were generally achieved by the larger male groups but the various levels of fertility were definitely not in direct relationship to the number of males present. Some of the intermediate sized groups equalled and in some cases surpassed the large groups as illustrated in Fig. 16. In other instances small numbers compared very well with much larger groups. The time of the year was an important consideration with respect to peak fertility. In February, it took about 18 days for the groups to reach their respective peaks, as illustrated in Fig. 17, whereas in April the high level occurred within 8 days.

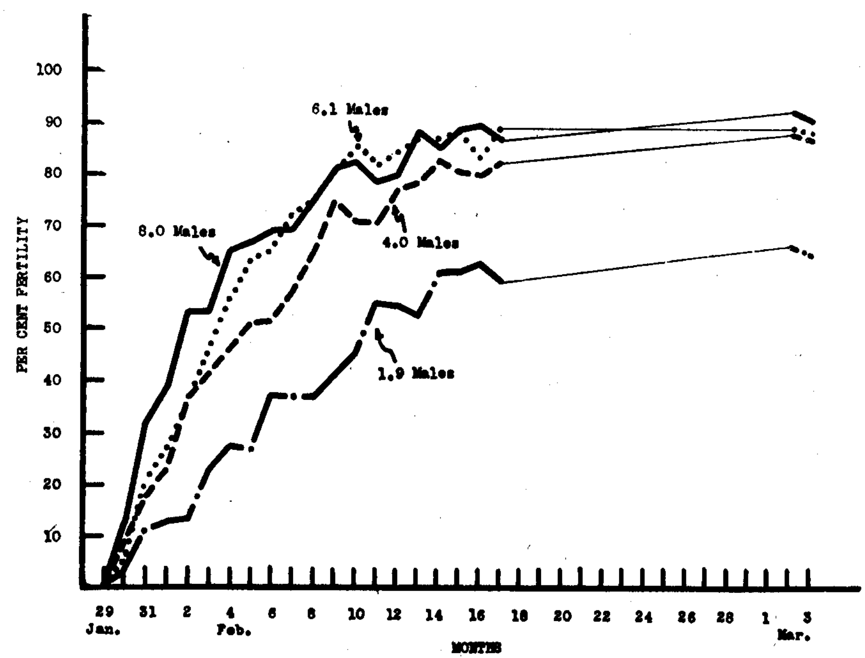

Figure 17—Fertility of eggs as effected by various sized male groups among approximately 100 hens.

The data indicate that, in general, less than 10 males per 100 females will give maximum fertility in flock matings. For this strain of White Leghorns 6 or 7 good males for each 100 hens may be expected to give as good fertility as a higher ratio of males to females.

Green Feed for Poultry

Experiments relating to the use of pasture and green feed shed some light on the value of this type of feed. Most of the studies were designed to test the efficiency of chopped alfalfa hay, fed moist, as a deterrent to feather picking, when used as a form of winter green feed. It was found that hay grown and used in the Harrow area was of definite value in feather picking control. It is interesting, however, to note that experiments with alfalfa grown and used at the Central Farm at Ottawa failed to duplicate the results obtained at Harrow. Investigations into the cause were not conclusive but it was felt that some element, so far unidentifiable, which provided protection against feather picking, might have been present in the Harrow alfalfa.

Influence of Feed Upon Interior Quality of Eggs

In connection with the experiments in the use of alfalfa hay as a supplement to a basal laying ration, the effects of such green feed on yolk color and albumen height of eggs were investigated. Fresh eggs as well as eggs held several months in storage were used to test these two conditions.

The data in Table 26 on yolk color were obtained by matching yolks of broken eggs with various shades on a color chart. Examples of 24 yellow shades were provided, starting at number 1, an almost white shade, to number 24 which was a deep orange. The figures under yolk color represent the average shade of yolk color of the group. Number 13, approximately the pale yellow shade ascribed to the group without green feed, was only 1½ shades lighter than yolks from the green feed pens.

The difference in height of the albumen in fresh eggs from both groups was very slight and the loss of height during storage occurred at an equal rate.

Table 26.—Effect of Alfalfa Hay on Yolk Color and Albumen Height of Eggs

	Yolk Color Average Depth of Yellow		Albumen Height Thousandths of 1 inch	
	Fresh Eggs	Stored Eggs	Fresh Eggs	Stored Eggs
Without Alfalfa	13·0	12·9	313	186
With Alfalfa	14·5	14·7	311	180

Restricting Feed to Pullets on Pasture

This experiment featured actual feed restriction as a means of inducing growing birds to eat more green feed. Two groups of 8-week-old pullets were placed on good alfalfa pasture and allowed 80 per cent and 90 per cent of the feed used daily by a similar group on full rations.

The results of this test showed growth and maturity to be delayed according to the degree of feed restriction. These facts indicate that savings in pasture are not a simple matter of replacement of feed. The data also suggest that the known properties of pasture might be utilized more completely by providing a full but simple and cheaper ration than by simply reducing the quantity of prepared feeds.

Second-Year Egg Production After Forced Molting

Several reports have shown that the usual decrease in egg production of second-year hens is about 20 per cent of the first-year yields. This lower rate of production has no doubt influenced most poultrymen in disposing of their stock after the first laying year. In keeping with this principle, modern practice has been directed to the use of first-year hens with the result that relatively little is known of how the newer procedures may influence second-year production. Forced molting, for instance, is a method of molt control sometimes used but details concerning its over-all effects are not generally known.

Forced molting is accomplished by placing hens on good pasture with water to drink but without grain for about five days. Whole oats are then provided at the rate of 2 ounces per bird daily for about three weeks and then the birds are given a full diet of mash and grain. After six weeks on range they may be re-housed on a regular laying ration. Egg production may be expected to start soon after housing and, as a rule, peak performance may be reached about 10 weeks after the birds are first placed on range.

Table 27.—Egg Production and Mortality of Leghorn Hens First and Second Season

Season	Average Egg Production		Mortality
	Survivors	Hens Housed	
			%
First	224	203	11
Second	199	166	22

Worked out in percentages the survivors during the second year laid close to 90 per cent of their production during the first year. On a hen-housed basis, which is a more critical standard, the second-year production was 82 per cent of the first.

Table 28.—Average Weight and Percentage of Grades of Eggs According to Age of Hens

Age of hens when eggs weighed	Grade (Minimum Weight)			Average weight of all eggs grams
	Large 57 grams	Medium 50 grams	Small 43 grams	
	%	%	%	
1 year	66·1	32·0	1·9	58
2 years	84·2	15·8	....	60

Measurements taken during the first ten days of March showed a higher proportion of large eggs during the second year. Hens tend to start the second year by laying large eggs while pullets commence the first year with eggs of smaller size.

The higher mortality observed among the second-year birds in the first test as shown in Table 27 might appear to be a serious consideration. However, in a second test which is now in progress, fewer hens died in the second year than in the first.

These tests also indicated that there may be genetic differences among strains in their laying ability during the second year. Two separate Leghorn strains made up the group and a comparison of the yields showed that one strain was about 8 per cent better than the other.

A Comparison of Broiler Strain Crosses

A phase of the work in the Poultry Division at the Central Experimental Farm, Ottawa, is the development of new breeds of poultry. One of these, a white feathered, broad breasted type, was given a test at Harrow for crossing ability. The parent stock at Ottawa was crossed with utility New Hampshires and the chicks sent by air to Harrow. Samples of chicks from other commercial strains as described in Table 29 accompanied them to act as controls.

Table 29.—Comparative Results of Broiler Crosses at 12 weeks

Breed	Number of birds	Body weight		Average Weight	Lb. feed to lb. gain	Mortality
		Males	Females			
						%
Meat Strain New Hampshires........	150	4·38	3·54	3·96	2·93	1·3
Meat Strain N.H. × Laying Strain Barred Rocks..................	150	3·73	2·89	3·29	2·97	2·0
Ottawa B.B. Whites × Ottawa New Hampshires.....................	150	3·87	3·00	3·44	2·77	1·3
Meat Strain N.H. × Meat Strain Barred Rocks..................	150	4·17	3·25	3·66	2·91	3·3

Both sexes of the broilers were reared together until disposed of at 12 weeks of age. Floor space provided was one and one-fifth square feet per bird.

Rate of growth for the Ottawa Broad Breasted Whites was slightly behind the groups in which meat type was undiluted. Conversion of feed to body weight, however, showed up very well in comparison with that of the other groups. Broilers from this cross also had the advantage of white feathering.

ACTIVE PROJECTS

Tobacco

Studies on supplementary irrigation for burley tobacco.
Commercial fertilizer studies on burley and dark tobacco.
Fertilizer formulae for cigarette burley.
Studies on dates and distances of planting burley tobacco.
Row-spacing tests on dark tobacco.
Height of topping tests on cigarette burley.
Methods of controlling sucker growth, dates and methods of harvesting, and crop rotation studies on cigarette burley.
Relation of preceding crop to tobacco crop returns.
Breeding and testing (Flue-cured, burley, and dark tobacco).
Breeding and selection for black root rot and brown root rot resistance.
Preliminary tests of foreign strains and domestic varieties.
Testing of calcium chloride dehydrater and curing equipment for curing burley.

Forage Crops

Breeding for improved agronomic features in field corn.
Breeding for resistance to the corn borer and root and stalk rots in corn.
Comparative testing of imported and locally developed corn hybrids.
The effect of spraying for corn borer control upon the yield of corn.
Developing improved varieties of soybeans by hybridization and selection.
Breeding soybeans for resistance to stem canker and other diseases.
Comparative testing of imported and locally developed soybean varieties.
Rates of seeding and spacing of rows of soybeans.
Tests on alternate planting of corn and soybeans.
Breeding improved strains and varieties of sunflowers.
Foundation stock seed of corn inbred lines and soybean varieties.

Horticultural Crops

Peach variety testing, pruning, rootstock, thinning and harvesting studies.
Apricot variety testing.
Early tomato breeding and variety testing.
Melon breeding and variety testing.
National potato trials.
Early vegetable rotation studies and soil building.
Processing Foundation vegetable seeds.
Greenhouse cucumber and tomato variety tests.
Testing of ornamental material for landscaping.
Greenhouse and outdoor chrysanthemum varieties.

Field Husbandry

Fertility studies on hybrid corn, early potatoes and oats.
Irrigation studies on early potatoes, early tomatoes, and burley tobacco.
Agro-meteorological studies.

Cereal Crops

Breeding, selection and strain testing winter wheat and oats.

Poultry Husbandry

Egg quality studies and tests for fertility.
Testing broiler strain crosses.
Testing environmental effects on poultry.
Evaluation of selection methods in poultry breeding.
Production studies with second-year hens.

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