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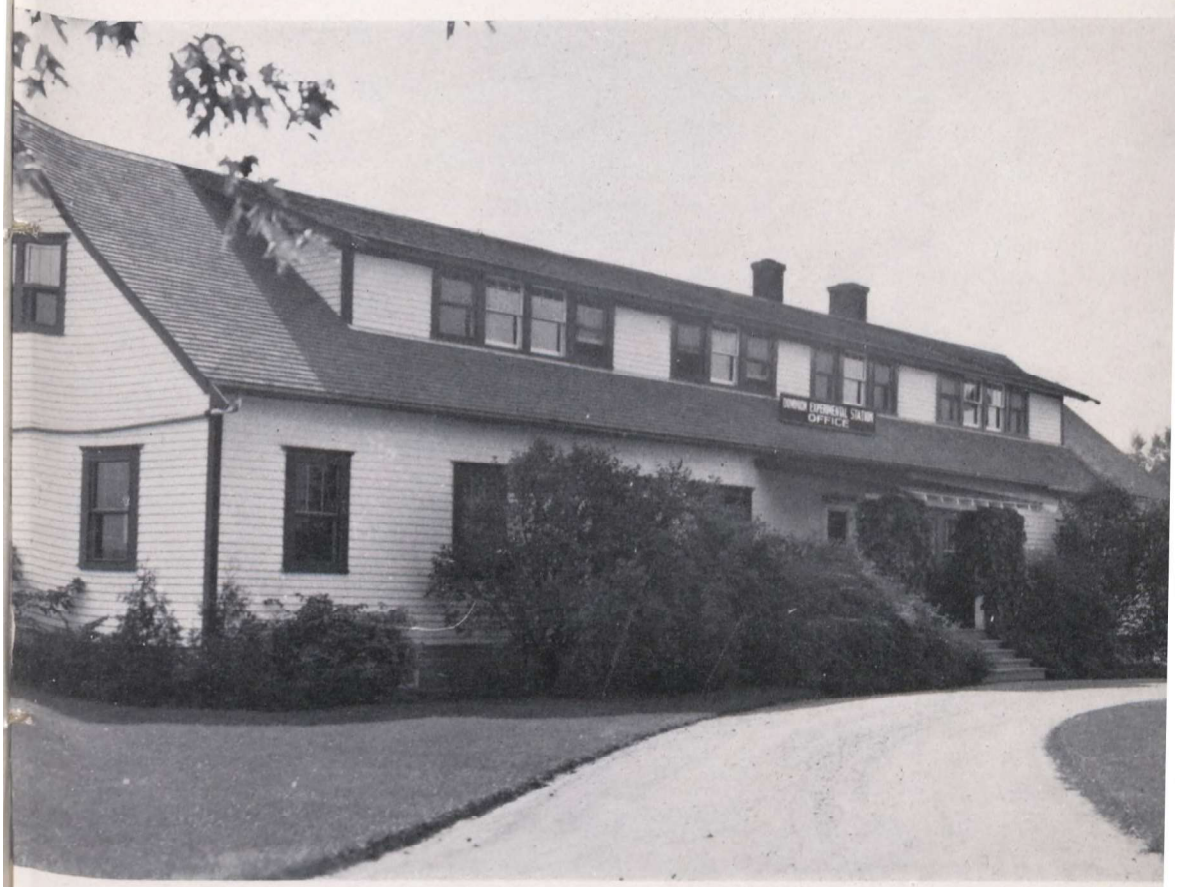
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS SERVICE

DOMINION EXPERIMENTAL STATION
HARROW
ONT.

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

PROGRESS REPORT
1937-1946



VIEW OF OFFICE, HARROW
DOMINION EXPERIMENTAL STATION

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PROGRESS REPORT

DOMINION EXPERIMENTAL STATION
HARROW, ONTARIO
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Introduction

The Dominion Experimental Station at Harrow, Ont., was formally established in 1923. For 14 years prior to that, experimentation with tobacco had been conducted on 50 acres of leased land, which later formed part of the Station property. The Harrow Station, situated in the extreme southwestern part of Ontario, is climatically suited for growing long season crops to maturity. Work is conducted on the many specialized crops of southwestern Ontario in the divisions of tobaccos, cereals, forage plants, field husbandry and horticulture. Poultry and animal husbandry projects are also carried on.

During the period under review two laboratories—one a Plant Pathology unit, the other Entomology—were established on this Station by Science Service of the Department of Agriculture.

In 1933 a Dominion Experimental Substation was established at Delhi, in Norfolk county, that is devoted to the study of practically all phases of flue-cured tobacco production. In 1946 a Dominion Experimental Substation was established at Woodslee, in Essex county, about 22 miles northeast of Harrow. The Woodslee Substation, located on Brookston clay soil in the centre of the corn and soybean growing district, is devoted in general to study of soils and crop production problems. The Delhi and Woodslee Substations are in charge of officers who are responsible to the Superintendent of the Harrow Dominion Experimental Station.

A progress report was published giving the results of experiments at both the Harrow Experimental Station and the Delhi Experimental Substation for the five years, 1932-1936. A progress report with results of experiments, 1937-1945, has been published for the Delhi Experimental Substation.

Tobacco

R. J. Haslam[1]

Production and Price Trends

To meet the demand of a steadily increasing cigarette trade, the trend in tobacco production in southern Ontario, particularly during the war years, was toward milder brighter leaf tobaccos. While large stocks of pipe and chewing tobacco were also used during this period the production of heavy bodied tobacco was not stimulated nearly to the same extent as cigarette tobacco.

This steadily increasing demand for bright tobaccos naturally stimulated the production of the flue-cured type. With burley it was chiefly a shift from heavy varieties formerly used for pipe and chewing to lighter standup varieties useful for manufacturing cigarettes and mild smoking tobaccos. Expansion in flue-cured tobacco has taken place entirely in what is now known as the "New

[1] Associate Superintendent and Senior Assistant, Tobacco.

Tobacco Belt" of Ontario. New production areas have become established in the counties of Elgin, Middlesex, Norfolk, Oxford, and Brant in the Lake Erie region; in Simcoe county in the vicinity of Georgian Bay, and in Durham county along Lake Ontario. During the same period, the production of flue-cured tobacco in Essex county has declined, with a general shift in land use towards vegetable crops, early potatoes and soft fruits on the light soils of this county. Meanwhile, the area planted with flue-cured tobacco in the New Belt increased from approximately 50,000 acres in 1937 to 90,000 acres in 1946.

The production of burley has been confined almost entirely to the Old Belt which includes Essex and Kent counties. During the period the acreage planted to burley was restricted although a natural control due to unfavourable planting conditions, particularly towards the end of the period, tended to keep production below leaf requirements. The largest area planted in any one year was 11,190 acres in 1939. The acreage planted in 1937 was 6,170 as compared with 10,500 acres in 1946. By 1946, Harrow Velvet and Haronova, two Harrow Station productions, had replaced old varieties to the extent of more than 60 per cent of the total production.

The area planted in dark tobacco varied during the ten-year period from a high of 3,000 acres in 1938 to a low of 1,099 acres in 1944, for an average annual production of slightly over 2,000 acres at the end of the period.

Although the average yield per acre of all types has fluctuated somewhat with the season, better fertilizing practices, improved cultural methods and better varieties have done much to improve the yields of tobacco in Ontario during the ten-year period.

The farm price of tobacco also fluctuated. During the five-year period, 1937 to 1941 inclusive, the average farm price in Ontario was 22·6 cents per pound for flue-cured tobacco, 16·9 cents per pound for burley and 12·5 cents per pound for dark tobacco. In the succeeding five-year period, flue-cured tobacco averaged 31·7 cents, burley 22·8 cents and dark tobacco 20·2 cents per pound. As these figures indicate, there was a definite upward trend in farm prices of tobacco during the ten-year period.

FIGURE 1.—TOBACCO PLANT BEDS AT HARROW

Types of beds and greenhouses utilized to study seedling production include cotton-covered beds in foreground at left, glass and synthetic covers in foreground centre, and permanent greenhouses in background.

Tobacco Seedling Production

A uniform supply of early, healthy tobacco seedlings has been found essential for a successful tobacco crop. Although the ordinary glass-covered cold frame and semi-hot cotton-covered plant bed still predominate in the burley and dark tobacco districts, more growers are realizing the benefits that may be derived from the more modern glass-house in use at Harrow. From periodic surveys in the district and investigations conducted over a period of years at Harrow, there is evidence to show that successful seedling production is more closely associated with procedure in plant-bed management than with any specific type of plant-bed construction.

Steaming the beds is recommended to control weeds and soil-borne diseases. Treating the woodwork, walks, and inside walls of a plant-bed with formaldehyde has proved worthwhile to guard against re-infestation of the plant-bed soil.

The use of farmyard manure is often the cause of tobacco seed-bed troubles and is not recommended, particularly in glass-covered beds. A tobacco fertilizer, such as a 2-10-8 or a 2-12-10 mixture, applied before steaming, at the rate of one pound per square yard, has given excellent results in the production of tobacco seedlings. Over-fertilization, particularly with nitrogen, should be avoided. The use of excessive nitrogen very frequently is the cause of plant-bed failures. The effects of using excessive quantities of nitrogen become more exaggerated when weather conditions are unfavourable for normal growth.

Sowing the seed dry, mixed in wood ashes or in fertilizer, at the rate of one ounce on 1400 to 1600 square feet of plant-bed is recommended. Cotton-covered beds usually require slightly thicker seeding than glass-covered beds. Tests have shown that sprouted seed has no real advantage over unsprouted or dry seed to promote the growth of seedlings. To procure a uniform stand of seedlings, tobacco seed should germinate at least 80 per cent. Poor germinating seed will be found slow in starting and the seedlings will vary in size. An area of approximately 100 square feet of seed-bed should provide sufficient seedlings for one acre of tobacco.

Tobacco beds must be properly ventilated to ensure a healthy condition in the young plants. The surface of the bed should not be allowed to dry until

Figure 2.—TOBACCO VARIETY TEST PLOTS FOLLOWING CORN IN THE ROTATION

Differences in resistance to brown root-rot account for the variation in growth of the varieties.

the tiny seedlings appear, then only sufficient watering should be done to promote rapid growth. "Tipping-out" of the tiny seedlings is usually caused from over-watering. Drying the bed off as soon as the tiny seedlings become established will encourage rooting and a better stand of plants. Temperatures between 80 and 90 degrees are most favourable for the growth of tobacco seedlings.

Three to four days before transplanting them, the seedlings should undergo a toughening or hardening-off process by withholding water and by giving as much ventilation as possible. Properly hardened seedlings give a more uniform stand of plants in the field and also save labour in replanting.

Tobacco Varieties

Varieties have played a major role in the development of the tobacco industry in southwestern Ontario. With the establishment of the tobacco substation at Delhi, testing of flue-cured varieties was discontinued at Harrow in 1938, except the breeding and testing program for black root-rot resistance, which has been continued at Harrow. Flue-cured varieties are discussed in detail in the Summarized Report of the Dominion Experimental Substation, Delhi, 1937-45. In recent years at Harrow, promising varieties have been developed from the breeding program on burley flue-cured and dark tobacco. Some of these varieties, particularly Harrow Velvet and Haronova, have broadened the use of burley leaf from a declining trade in chewing and plug tobaccos to a steadily increasing volume of this kind of leaf now going into cigarette blends and other mild smoking tobaccos.

Burley Varieties

Variety work on burley tobacco during the period has been conducted under four major headings, breeding and selection for black root-rot resistance, testing for brown root-rot resistance, comparative tests of commercial varieties, and the study of new introductions from the United States. The results of these investigations have brought into production several excellent varieties.

A classification study which was conducted previous to 1937 served a useful purpose in arranging burley varieties according to type, maturity, etc. In more

Figure 3.—TOBACCO VARIETY TEST PLOTS ON BLACK ROOT-ROT SOIL
Rows on left are Judy's Pride, a susceptible variety, and the rows on right are Harrow Velvet, a resistant burley variety.

recent years a further grouping of the varieties, to place them in their relative position regarding commercial use, has had a further practical application. In this connection burley varieties have been divided into three groups. The first group consists of cigarette or mild smoking varieties which include Harrow Velvet, Haronova, Harmony, Gay's Yellow and Kentucky No. 52. The second or intermediate group includes such varieties as Halley's Special, Judy's Pride, Harrow Broadleaf and several Kentucky varieties. The third group consists of wrapper or export varieties which include Green Briar, Kelley and Station Standup.

Harrow Velvet may be considered the leader of the cigarette group of burley varieties, because with its introduction in 1931 a new class of burley tobacco came into existence. Burley varieties in use previous to 1931 consisted chiefly of the heavier type, adapted best for manufacturing pipe and chewing tobaccos. The demand for these heavier varieties had begun to fall away; lighter coloured leaf was preferred by the manufacturer. Harrow Velvet filled the requirements much better than the older varieties, being brighter in colour and finer in texture. Harrow Velvet was the first cigarette burley variety at Harrow to manifest a high resistance to black root-rot, which naturally added further to the popularity of this variety from the growers' standpoint.

Harrow Velvet has been found a useful variety in the burley breeding program at Harrow. In crossing it with Station Standup and Halley's Special, Haronova was introduced in 1941 and Harmony in 1945. Both Haronova and Harmony are very resistant to black root-rot. These varieties are capable of producing high quality cigarette leaf and under average conditions yield slightly higher than Harrow Velvet. Other varieties fitting into the cigarette class include Kentucky No. 52 and Gay's Yellow. Kentucky No. 52 is resistant to black root-rot while Gay's Yellow is definitely susceptible to this disease. While the majority of varieties in the cigarette class of burley manifest a relatively high resistance to black root-rot, they are susceptible to brown root-rot and for best results they should not follow corn, soybeans, or timothy hay in the crop rotation because of the tendency of these crops to promote brown root-rot, particularly when burley tobacco is grown on light soils.

Experiments have proved that, for best results, cigarette burley varieties should be planted medium early (May 25 to June 5). Early planting provides a longer season for maturity which is essential with this class of tobacco so that the crop can be harvested when conditions are most favourable for curing. Cigarette varieties are susceptible to cool conditions at harvest and during the curing period. By regulating a timely procedure in planting, topping and harvesting of these varieties much can be done to improve the quality of cigarette burley.

TABLE 1.—AVERAGE YIELD OF CIGARETTE BURLEY VARIETIES WHEN PRECEDED BY ALFALFA, CORN AND TOBACCO (1941-1946)

Variety	Preceding Crop		
	Alfalfa	Corn	Tobacco
	lb.	lb.	lb.
Haronova	1,726	1,322	1,529
Harrow Velvet	1,622	644	1,460
Harmony*	1,671	582	1,320
Kentucky No. 52	1,532	477	1,300
Gay's Yellow	1,518	985	419

* (1945-1946 only)

In the intermediate group of varieties, Harrow Broadleaf, Halley's Special and Judy's Pride are susceptible to black root-rot. These varieties, therefore, should be planted in a well planned crop rotation to prevent the occurrence of black root-rot.

Other varieties falling in the intermediate group include Kentucky No. 16, Kentucky No. 41 and Kentucky No. 19. The Kentucky varieties are resistant to black root-rot but none possess the fine leaf quality of the more susceptible varieties.

TABLE 2.—AVERAGE YIELD OF INTERMEDIATE BURLEY VARIETIES WHEN PRECEDED BY ALFALFA, CORN AND TOBACCO (1941-1946)

Variety	Preceding Crop		
	Alfalfa	Corn	Tobacco
	lb.	lb.	lb.
Halley's Special	1,622	508	1,002
Judy s Pride	1,517	1,012	736
Harrow Broadleaf	1,633	927	1,321
Kentucky No. 16	1,638	738	1,366
Kentucky No. 19	1,755	1,252	1,420
Kentucky No 41-A	1,855	1,450	1,410

The wrapper leaf or export group, consisting of Green Briar, Kelley and Station Standup, are all susceptible to the black-root, and usually yield best when grown on properly drained soils in crop rotations with a duration of four or more years. On the other hand, these heavier varieties have manifested a relatively high degree of resistance to brown root-rot, and will be found to grow reasonably well after corn or soybeans when other burley varieties may fail to grow.

TABLE 3.—AVERAGE YIELD OF HEAVY OR WRAPPER LEAF BURLEY VARIETIES WHEN PRECEDED BY ALFALFA, CORN AND TOBACCO. (1941-1946)

Variety	Preceding Crop		
	Alfalfa	Corn	Tobacco
	lb.	lb.	lb.
Green Briar	1,938	1,533	428
Station Standup	1,959	1,148	320
Kelley	1,562	1,067	479

Dark Tobacco Varieties

Although several varieties and strains of dark tobacco have been introduced in recent years, none has manifested a satisfactory resistance to black root-rot. In breeding for black root-rot resistance in this type of tobacco, difficulty has been experienced in combining the two important factors, heavy body, and black root-rot resistance, in a single variety. However, some progress has been made in that connection in recent years at Harrow.

At present, Greenwood and Little Crittenden are the principal dark varieties grown. Both are suitable wrapper types and may be either air-cured or fire-cured with equally good results. Unfortunately, both varieties are highly susceptible to black root-rot, and must be grown in a fairly long crop rotation in which tobacco does not occur more than one year in five or six years. Strains 5058

and 5054 are Harrow productions which have manifested a moderate resistance to black root-rot. Both these strains outyield Greenwood and Little Crittenden on black root-rot infested soil. Average yields for the period are shown in Table 4.

TABLE 4.—AVERAGE YIELDS OF DARK VARIETIES AND STRAINS OBTAINED IN CROP ROTATION FOLLOWING ALFALFA AND ON BLACK ROOT-ROT INFESTED SOIL FOLLOWING TOBACCO. (1937–1946).

Variety	Following Alfalfa	Following Tobacco
	lb.	lb.
Greenwood	1,496	437
Little Crittenden	1,685	550
Strain 5058	1,395	910
Strain 5054	1,361	723

Crop Rotation and Crop Effects

The production of burley and dark tobaccos is suitably adapted to a crop rotation system. Maintenance of soil fertility with these types of tobaccos has not been a difficult problem. It has been found, however, that for best results careful consideration should be given to the arrangement of the crops in the rotations in order that crop effects may be beneficial rather than detrimental to the tobacco crop.

FIGURE 4.—BURLEY TOBACCO ROTATION PLOTS

A number of crop rotations for burley tobacco have been studied over a period of years to determine their effect on the crop and their value for maintaining soil productivity.

Several systems of cropping have been studied at Harrow over a period of years. Results of these experiments have clearly indicated the advantage of crop rotation over continuous planting of tobacco. Long rotations have shown no special advantages over short rotations, particularly on sandy loam soils at the Station. The yields of burley tobacco from different cropping systems, conducted in successive periods between 1925 and 1946, presented in Table 5, are typical responses from burley tobacco in the rotations practised.

TABLE 5.—AVERAGE YIELDS OF BURLEY TOBACCO OBTAINED FROM DIFFERENT CROPPING SYSTEMS IN SUCCESSIVE PERIODS, OVER 22 YEARS, 1925–1946

Length of Rotation	Crops Included	Yield per acre
		lb.
Old Series (1925–1935)—		
Continuous Planting...	Tobacco every year	1,164
Three years	Oats, mixed hay, tobacco	1,398
Four years	Corn, oats, hay, tobacco	1,369
Five years	Corn, oats, hay, 2 years Tobacco	1,313
Intermediate Series (1936–1942)—		
Three years	Oats, sweet clover, tobacco	1,847
Four years	Oats, soybeans, corn, tobacco	1,211
Five years	Wheat, 2 years, alfalfa, corn, tobacco	1,554
Six years	Corn, oats, 2 years, alfalfa, wheat, tobacco	1,559
Late Series (1943–1946)—		
Three years	Oats, sweet clover, alfalfa	1,619
Three years	Soybeans, oats (rye, tobacco rye)	1,559
Four years	Corn, oats, alfalfa, tobacco (rye)	1,748
Four years	Soybeans, oats, alfalfa, tobacco (rye)	1,634

In this series of experiments, the lowest yield was obtained from continuous planting of tobacco, even though a variety resistant to black root-rot was grown. The crop sequence has influenced the yield of burley to some extent in the crop rotations. Corn, particularly when preceded by soybeans, lowered the yield of burley considerably. Sweet clover and alfalfa were found beneficial crops when preceding burley. There appeared to be no special advantage derived from extending the rotation longer than four years. The three- and four-year rotations appear to be most satisfactory under sandy loam conditions. The introduction of a rye cover crop in the late series was found less effective in supplying organic matter than alfalfa sod. Barnyard manure and 1000 pounds commercial fertilizer were applied regularly to the tobacco crop in each system of cropping.

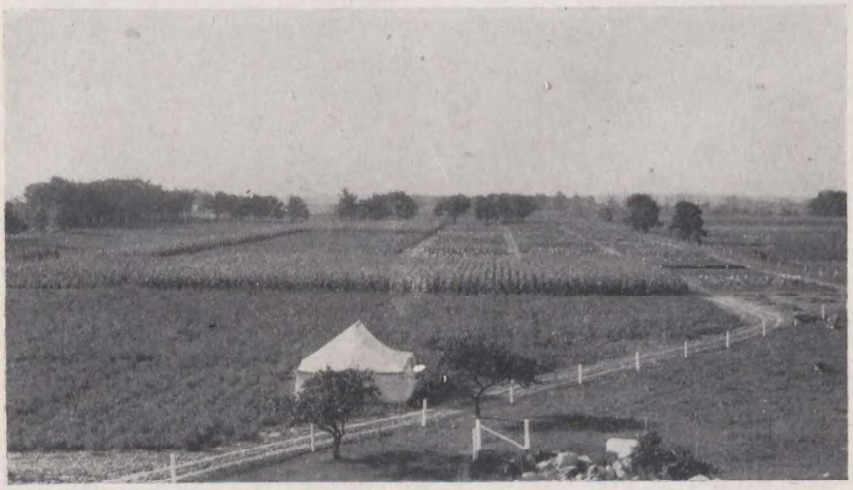

FIGURE 5.—EXPERIMENTAL PLOTS IN ONE FIELD AT HARROW
Tobacco crop rotations are shown in background, corn plots in centre and early tomato plots in foreground.

Fertilizers for Burley Tobacco

Burley tobacco responds readily to commercial fertilizers. The quantity that may be utilized effectively depends on the supply of active organic matter in the soil, on manure applications and on the type of soil. Burley tobacco soils vary a great deal in texture and fertility; mixtures, therefore, should be chosen to suit the individual soil conditions.

Extensive fertilizer experiments have been conducted on the sandy loam soils of the Station, throughout the period covered by this report, to study different mixtures, rates and methods of application. Co-operative tests on heavier soils have been extended in the district. Information gathered from these experiments has formed a basis for recommendations for burley on the principal soil types.

A 4-8-10 fertilizer mixture, at the rate of 500 to 1000 pounds per acre, is recommended for sandy loam and gravelly loam soils. The fertilizer mixtures, 2-12-10 and 3-10-6, at the rate of 500 to 800 pounds per acre, have been found to give effective results on the heavy soils. The results expressed in Table 6 are typical of the response from fertilizers applied to burley on different soil types. It will be noted in this table that during the period in which these tests were conducted the gross returns obtained per acre were highest from fertilizers which contained the higher level of available potash.

TABLE 6.—AVERAGE YIELDS AND GROSS RETURN PER ACRE WITH FERTILIZERS APPLIED TO BURLEY ON DIFFERENT SOIL TYPES (1936–1939)

Soil Type and Fertilizer Formula	Average Yield per acre	Gross Return per acre
	lb.	$
Harrow Sandy Loam—		
4–8–10	1,690	240
2–12–10	1,589	243
4–8–6	1,619	225
2–12–6	1,516	221
Gravelly Loam—		
4–8–10	1,715	274
2–12–10	1,812	262
4–8–6	1,754	261
2–12–6	1,554	221
Clay Loam—		
4–8–10	1,707	239
2–12–10	1,731	242
4–8–6	1,742	209
2–12–6	1,774	203

Methods of Application

The band method of application, using the fertilizer attachment on the tobacco planter, has proved advantageous on the lighter soils. If the fertilizer is applied with a grain drill attachment, it should be placed to a depth of three to four inches where it may be properly utilized by the growing crop. When fertilizer is applied in the row it should be thoroughly mixed with the soil before transplanting, to avoid burning the roots. Broadcasting the fertilizer on the surface and disking it into the soil is not recommended because this method wastes fertilizer.

Fertilizers for Dark Tobacco

Dark tobacco responds effectively to well balanced soil fertility. Although proper maturity is essential for quality leaf, steady growth is preferred to rapid growth for the development of a stretchy, thick leaf desired in this type of tobacco. The nitrogen requirements are found to be slightly higher for dark

Figure 6.—GENERAL VIEW OF BURLEY TOBACCO FERTILIZER PLOTS AT HARROW

Results of experiments are reviewed by the Standing Committee on Tobacco Fertilizers for Ontario.

than for burley on similar soils. On the other hand, the requirements are found less exacting regarding available phosphate and potash. The 4-8-10, 4-8-6 and 3-10-8 mixtures meet the requirements of the majority of dark tobacco soils. The use of 600 to 800 pounds per acre is required for maximum crop yields under average conditions.

Cultural Practices

The distance separating tobacco plants in the field is known to affect both yield and quality of the cured leaf. Varieties may react differently when planted the same distance apart. Variation in soil type and soil productivity may also influence the results, when making comparisons on spacing. Furthermore, spacing in the field tends to regulate, not only the size of the leaf, but the size of the plant. This may affect maturity and incidentally the curing process. It is essential, then, that the proper distance of planting be used to get maximum returns from any variety of tobacco.

From results of experimental work conducted over a period of years at Harrow, spacing of 22 to 24 inches in rows 40 inches apart is recommended for the cigarette varieties, and with certain other varieties under soil conditions which tend to produce a heavy, sappy stalk. Closer spacing in the row may be

found advantageous in reducing the size of the stalk. Too wide spacing retards maturity. The heavy leaf varieties usually have responded best to slightly wider spacing, 26 to 28 inches apart. Table 7 presents the average yields and gross returns per acre for Harrow Velvet burley spaced 21, 24 and 28 inches, respectively, in rows 40 inches apart.

TABLE 7.—AVERAGE YIELDS AND RETURNS PER ACRE WITH HARROW VELVET BURLEY SPACED AT DIFFERENT DISTANCES IN ROWS FORTY INCHES APART (1937-1939)

Spacing in Rows 40 inches Apart	Maturity Index	Average Yield per acre	Average Return per acre
	value	lb.	$
21 inches	110	1,779	308
24 inches	96	1,685	273
28 inches	72	1,555	248

Closer spacing naturally increases the number of plants to be handled at transplanting and also requires greater space to hang an acre of tobacco. These disadvantages, however, are offset in obtaining a better grade of tobacco and a higher acre return.

To mature the upper region of the tobacco plant, proper topping at a medium height when the first flower appears is recommended. The average variety of burley is capable of maturing 14 to 16 good leaves. High topping delays maturity and usually lowers the quality of burley and dark tobacco. In the case of Harrow Velvet, which normally possesses more leaves than the average variety, slightly higher topping (18 to 20 leaves) is recommended. Low topping is essential for body in the export varieties of burley. Topping dark tobacco nine to eleven leaves, after three or four of the bottom leaves have been discarded, makes for the best wrapper quality of leaf.

Timely removal of suckers is conducive to both quality and yield of burley and dark tobacco.

Maturity Studies

Ripe tobacco is one of the first essentials for quality leaf, particularly with the cigarette varieties. Under average conditions in southwestern Ontario it requires between 90 and 110 days from the transplanting period till harvest to bring the present varieties of burley to full maturity. Naturally, this period of growth may be influenced greatly by the conditions that prevail during the growing season. Moderately early planting (May 25 to June 5) is recommended

TABLE 8.—AVERAGE YIELDS AND RETURNS PER ACRE FROM HARVESTING CIGARETTE BURLEY DIFFERENT DATES AFTER TOPPING. (1937-1940)

Number of Days After Topping	Average Yield per acre	Average Return per acre
	lb.	$
21 days	1,287	194
28 days	1,427	195
35 days	1,572	269

for cigarette burley, particularly the black root-rot resistant varieties. Early planting usually results in early harvesting and better weather conditions for curing the crop. The majority of cigarette tobacco varieties are sensitive to low temperatures at harvest time and during the early part of the curing period.

The important period in maturity of tobacco is between topping and harvest. The majority of varieties require at least four weeks after topping to reach full development and maturity. This fact is clearly demonstrated in Table 8.

Since the majority of heavy burley varieties and dark tobacco varieties are susceptible to black root-rot it has been found advisable to delay transplanting a few days with these varieties or until the time that the soil becomes warm. Low soil temperatures encourage black root-rot. When susceptible varieties are planted too early, the plants start slower and take a longer season to develop. It is recommended that transplanting of the heavy varieties be delayed until June 5 to 15 depending on the season.

Forage Crops

G. F. H. Buckley; C. W. Owen; C. G. Mortimore[2]

For the greater part of the ten years under review, forage crop investigations have emphasized the breeding and testing of hybrid corn and soybeans. In 1945, a sunflower breeding program was added for the purpose of improving the local strains.

Corn and soybeans are grown almost exclusively for grain in the extreme southwestern portion of Ontario. Therefore, in the testing and breeding of these crops, features relating to production and quality of grain receive greatest consideration. Nevertheless, their forage value is not overlooked.

Field Corn

During the ten-year period, 1937 to 1946, there has been almost a complete change over from the use of open-pollinated varieties of corn to that of hybrids. Prior to 1938 very little hybrid corn was grown in Ontario except on Pelee Island and in a few fields scattered through the adjacent mainland. From 1939 to 1941 there was a definite swing to hybrid corn. Tests at the Experimental Stations in Ontario showed the general superiority of hybrids over the open-pollinated varieties and this, coupled with the intensive advertising campaign of the commercial hybrid seed producers, caused the hybrids to replace the old varieties very rapidly. By 1941 about 75 per cent of the corn acreage in Essex and Kent counties was planted with hybrid seed. Today in this area the percentage is easily ninety-five. Indeed, it is hard to find fields of open-pollinated varieties, other than special seed lots. The use of the hybrids is extending rapidly eastward into what has been known as the ensilage corn area. The early hybrids are grown for grain, thus extending the husking corn area, and the later maturing hybrids are harvested for ensilage.

Corn hybrids in general use will outyield the open-pollinated varieties of similar maturity rating by 10 to 20 per cent. It is not yielding ability alone, however, that has won the corn grower over to hybrids. The stronger root systems and sturdier stalks of the hybrids result in less lodging, thus making harvesting, whether by hand or by the mechanical pickers, much easier. This feature alone is responsible for many growers changing to hybrids.

[2] Senior Assistant, and Assistants, Forage Crops respectively.

Corn Breeding

Corn investigations at the Dominion Experimental Station, Harrow, are confined to breeding and testing. The latter is naturally very closely associated with the breeding program for in the tests the hybrids produced at Harrow are compared with the best imported hybrids.

In 1937, the breeding program was conducted along two lines, (*a*) the development of improved open-pollinated varieties and (*b*) the development of inbred hybrids. Through a method of controlled pollination, a strain of yellow dent corn of medium maturity and known as Golden Glow (Harrow) was developed. Similarly, a strain of Silverking was being developed. In 1940, this type of breeding was discontinued in favour of inbred hybrids.

Inbred Hybrids

In developing a hybrid, certain objectives are constantly before the plant breeder. Some of the more important features governing selection throughout the whole breeding program are high yield, good quality of grain, sturdiness of stalk, strong root system, suitable maturity, medium height of plant and ears, moderate ease of husking and resistance to disease and insect pests.

Inbred Lines

The first step in the development of a hybrid is the establishment of inbred lines, which involves an intensive program of self-pollination for five or six generations accompanied by rigid selection. Most of the inbred lines at Harrow have been extracted from local and imported strains or varieties of open-pollinated corn and also from single crosses and imported hybrids. During the second and fourth generations of inbreeding, the lines are top-crossed to an open-pollinated variety to test their combining ability. Only the best combining lines are carried on to later generations.

While hundreds of inbred lines have been developed and tested at Harrow, only twenty have proved of sufficient merit to use in the present breeding

Figure 7.—HYBRID CORN SEED PRODUCTION

Production of "Canada" hybrids is an important industry in southwestern Ontario. Two rows of the male parent (with tassels) are shown in centre and six rows of female parent (with tassels removed) on either side.

program. From 1937 to 1946 over one hundred inbreds have been imported from the United States Experiment Stations, covering the area from New Jersey to Nebraska and Minnesota to Kentucky. Many of the imported inbreds proved to be altogether too late in maturing or otherwise unsuited for use in the breeding program. However, several from Wisconsin, Illinois, Indiana and Ohio have proved very valuable and are found in combinations with the local inbreds in the better Harrow hybrids.

Single and Double Crosses

Both single and double crosses were produced on a trial and error basis before 1941. Inbreds were combined into single crosses. The most promising ones were then combined to form double crosses. These were tested against proved commercial hybrids. A new plan of testing, developed in the United States, was adopted at Harrow in 1941. By this method of testing, the double-cross values for yield and maturity of any hybrid may be predicted from the data obtained from single-cross tests. From 1942 to 1946 the predicted values of over 2,000 double-cross combinations have been determined, and the best combinations made up and tested at Harrow and elsewhere in Ontario. Some of these have competed most satisfactorily with the imported commercial hybrids.

The breeding program at Harrow is just beginning to bear fruit. Three hybrids, designated Harvic 222, 300 and 333 have been licensed for production and sale in Canada. Harvic 300, which is the first Canadian inbred hybrid in commercial production in Canada, has not only proved its worth in Ontario but has performed exceptionally well in the states of Wisconsin and New York. An early maturing experimental hybrid, Harrow 458, has performed splendidly in tests at Ottawa and Guelph in recent years.

Production of "Canada" Hybrids

The Canadian producers of Wisconsin hybrids obtained their crossing stocks from the University of Wisconsin during the first few years of hybrid corn production in Canada. In 1940 the Ontario hybrid seed producers were notified

Figure 8.—A GOOD FIELD OF CANADA 696 GROWN ON SANDY LOAM SOIL

by the authorities in Wisconsin that no further crossing stocks would be exported from the State. In order that the Ontario producers might continue to produce seed of the Wisconsin hybrids, the Ontario Corn Committee made arrangements with the Dominion Experimental Station at Harrow and the Provincial Experimental Farm at Ridgetown, Ont., to produce the necessary crossing stocks. The inbred lines were to be maintained and multiplied at Harrow while the Experimental Farm at Ridgetown had the responsibility of making and distributing the necessary single-cross parent stocks. This program is still in effect and has proved very successful. Over fifty per cent of the hybrid seed planted in Ontario during 1946 was the product of this program. The hybrids of Wisconsin origin which are produced under this program are designated "Canada Hybrids". They differ from the Wisconsin hybrids of the same number only in that the breeding stocks are now maintained in Canada.

Regional Corn Tests

The Ontario Corn Committee, composed of officials of the Dominion and Provincial Departments of Agriculture, is responsible for seeing that hybrid corn tests are conducted and for making recommendations based upon the data gathered. The direct supervision of the tests is placed in the hands of the Dominion Experimental Station, Harrow; the Western Ontario Experimental Farm, Ridgetown; the Ontario Agricultural College, Guelph; and the Division of Forage Plants, Central Experimental Farm, Ottawa. This testing work was started in 1939 and has now been extended to cover the five corn zones in the province from Harrow to Ottawa.

A recommended list of hybrids is issued by the Ontario Corn Committee each year. All of these are licensed for sale and production in Canada. These hybrids have been placed on the list because of their superior performance in the regional tests and each one has shown itself to be adapted to a particular zone or section of the province. The latest list of hybrids, recommended for Ontario with an accompanying zone map may be obtained from the nearest Experimental Station or Agricultural Representative.

Testing Harrow Experimental Hybrids

The experimental hybrids undergo rigid testing. Not only must they compete among themselves but they must stand up against the best imported hybrids of similar maturity rating. The hybrids are first tested at Harrow. Each is closely studied for yield, sturdiness of stalk, ear quality, and resistance to disease and insect pests. In all the tests the better imported hybrids are used as checks and the Harrow combinations must be better than, or at least equal to these check hybrids. Any that do not meet this competition are eliminated. After two years of testing at Harrow, the best experimental hybrids are placed in the regional tests where they meet the severest competition from the very best of the imported hybrids. Some thirteen hundred experimental hybrids have been tested since 1939.

Sunflowers

While the sunflower is not a major crop in Essex county, there is a considerable quantity of seed produced to supply the pet food market. The crop, as grown at present, is a mixture of types, varying greatly in height, branching habit, and seed colour. The crop is mostly harvested by hand. There is need of a uniform type that may be harvested with the combine. The new Western Canada varieties have been tried but have not proved as satisfactory as the local strains. In 1945 it was decided that some breeding work should be undertaken. That spring, seed of the local strain was separated into colour groups. Seed of

each group was planted in separate plots and the resulting plants carefully selected for height and non-branching habit. Seed was obtained from the selected plants by bagging the heads prior to pollination. Inbreeding and selection is being continued, with the objective of developing an improved variety suited to the district.

Soybeans

The ten-year period under review has seen a great advance in the importance of the soybean crop in southwestern Ontario. This expansion may be credited to the increased requirements for oil and protein brought about by wartime conditions and higher prices paid for soybeans. Other factors must also be considered. The soybean crop is well adapted to this district and is a crop which does not require a large amount of hand labour. The soybean's leguminous properties appeal to farmers from the standpoint of soil fertility. The establishment of an additional soybean oil extraction plant in Ontario has increased the crushing facilities beyond the indicated potential producing capacity of the district. The increasing importance of the soybean crop in Ontario is indicated by the acreage increase from 8,000 acres in 1939 to 60,000 acres in 1946.

Soybean work at Harrow during the ten years under review has included: (*a*) a breeding program which has produced new strains, (*b*) the testing of the new strains and standard varieties produced here and in the United States and (*c*) some work on cultural practices. In the early part of this period the varieties A.K. (Harrow), O.A.C. 211, Manchu and Mandarin were the only ones available to growers. During the intervening years, the varieties Manchu and O.A.C. 211 have greatly decreased in popularity while three United States varieties namely, Lincoln, Richland and Earlyanna have been introduced. One new variety, Harman, has been introduced from the Harrow Station and is being well received. A description of the soybean varieties available in Ontario and the climatic zones in which they are adapted is presented in the publication "Guide to Crop Production in Ontario", prepared by the Ontario Standing Committee on Field Crop Improvement.

Soybean Breeding

A rather extensive breeding program is being conducted at Harrow in order to produce new varieties which will be either an improvement on the existing varieties or will provide a variety in a maturity group not yet adequately supplied. Crosses are made, using both imported and local varieties and strains, in an attempt to obtain new segregating material for selection purposes. The use of back-crossing is employed where strains would appear to benefit from this process. Pollinations were made by hand on plants grown in pots each year. While this slow, tedious process limits the number of crosses, which can be made in any one year, a fair measure of success has been obtained. The crosses are carried to the second generation where any obvious selfs are discarded. The remaining hybrid lots are bulked until the fifth or sixth generation when selections are made. During the ten-year period, some 5,000 selections have been made, grown as plant progenies for observation, and the most promising carried on to further tests. From this procedure, a number of very promising strains are now on hand.

Variety Tests For Seed

In the variety tests, new imported varieties and Harrow strains are compared with the standard varieties more generally grown. This is the proving ground for the Harrow strains. They must give a satisfactory performance, over several seasons, before they are released to the growers.

A series of tests, distributed through Essex and Kent counties, was inaugurated in 1946 to further evaluate the new strains. These tests serve the purpose of determining the reaction of the new strains on soil which is more typical of that generally devoted to soybeans than the Station soil, and under seasonal conditions where new, better adapted varieties would be an asset to the crop. It is felt that the tests should be extended to two or three more districts where some of the earlier strains would show to better advantage. The information so far obtained on the performance of the new strains is very encouraging in relation to that of the varieties now being grown in the various districts.

Soybean Seed Production

When desirable new strains are obtained, these are multiplied in a small way to determine their stability. In some cases it is necessary to make further plant progeny selections in order to stabilize the strains. The process has been used with several strains and has also been used with good success in a disease elimination program with the A. K. (Harrow) variety. At present several new

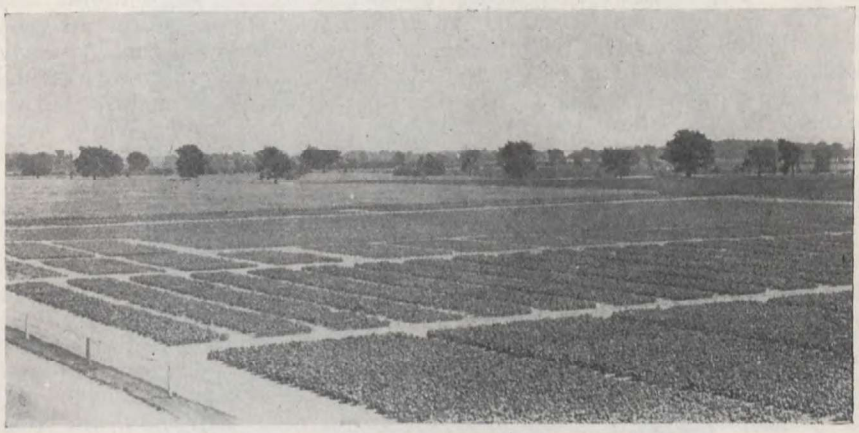

Figure 9.—A portion of the soybean test plots on the Harrow station

strains are available which should prove valuable to the soybean crop. The one new variety, Harman, which has been released is being quite widely grown. The seed supply of this variety has just become adequate to fulfil the demand. While the complete area in which this variety will be adapted has not yet been determined, its earlier maturity will permit it to be grown over a considerable part of the soybean producing district.

In addition to producing new varieties, the work at Harrow includes the maintenance of pure seed stocks of the two varieties A.K. (Harrow) and Harman. While large supplies of this class of seed cannot be produced, the responsibility for these seed stocks must be assumed. Considerable care must be taken of this seed and the plots carefully watched and rogued at various intervals. Where off-types occur, either through mixing at threshing time or mutations, these must be removed. On occasion it has been found advisable to resort to making a number of plant selections and establishing plant lines as a basis for maintaining the variety. This phase of the work will be increased as new varieties are introduced.

Cultural Practices

Cultural practices have been investigated to determine the best rates of seeding and the best spacing of rows for soybeans. The rates of seeding in these tests varied from fifteen to sixty pounds per acre, while the row spacings used were 22, 28, 30 and 36 inches. In general, it was found that the 28- and 30-inch row spacings, using 30 pounds of seed per acre, gave the better results. With shorter-growing varieties, narrower row spacings could be used satisfactorily. These results are in general agreement with the published results of similar experiments, although the amount of data on such work is not extensive.

Horticultural Crops

T. B. Harrison[3]

Previous to the period covered by this report, the work undertaken consisted of variety testing of early tomatoes, asparagus, raspberries, strawberries and other horticultural crops in addition to some fertilizer and cultural studies with early tomatoes and asparagus. In 1937, a fruit specialist was assigned to work on tender fruits and a collection of peach varieties was begun. A vegetable specialist was appointed in 1942 and some work on early potatoes was undertaken along with a breeding and testing program on early melons and early tomatoes. Both of these men were on active service during World War II and it was not until late in 1945 that a full program of work resumed.

FRUIT

Peach Variety Testing

Peach growing in southwestern Ontario is becoming more important. This interest on the part of growers brought about the establishment of a variety testing orchard on the Harrow Station which now contains 80 varieties. In 1945 the trees bore their fourth commercial crop and some preliminary information about the varieties has been obtained. Peach varieties at Harrow have, in general, ripened from four days to a week in advance of the same varieties in the Niagara Peninsula.

The present markets for peaches demand an attractively coloured good shipping yellow-fleshed freestone peach which can either be shipped to distant markets, sold locally on the roadside stands or to the canning factories. All varieties in the orchard have withstood the comparatively mild winters since 1940 but severe frosts during bloom have occurred on two occasions, which caused marked blossom injury to the following promising or established varieties in 1946; Golden Jubilee, July Elberta, Golden Globe, Sunhigh, Golden East, Valiant, Summercrest, Redelberta, Stark's Early Elberta, and Elberta. By contrast, the self-sterile varieties Pacemaker, Welcome and Halberta Giant bore only light crops in 1945, when pollinating conditions were unsatisfactory, but withstood the frost and yielded heavy crops in 1946.

The earliest ripening variety of promise at Harrow as of 1946, is Fisher, which is semi-clingstone and is a very heavy annual bearer. Sunbeam, a New Jersey introduction, follows Fisher by a few days, is somewhat smaller in size of fruit but of very much better quality. Oriole is now an established variety which ripens with Sunbeam but bears heavy crops of unattractive greenish yellow fruit. Red Haven ripens a little later than Oriole but the highly coloured firm fruit of Red Haven is unquestionably superior and the variety is being heavily

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FIGURE 10.—(top) PEACH VARIETY TESTING ORCHARD AT HARROW

FIGURE 11.—(middle) THE 6 QUART HEAPED LENO PEACH BASKET

FIGURE 12.—(bottom) THE BRITISH COLUMBIA PEACH BOX

planted in the district. Golden Jubilee is the outstanding early mid-season variety although somewhat late in coming into bearing and susceptible to spring frosts. To supplement or follow Golden Jubilee, three comparatively new varieties have shown up well. They are Early Halehaven, Triogem and July Elberta. Golden Globe and Sunhigh, both from New Jersey are promising varieties which ripen before Halehaven and Valiant. Following the mid-season varieties, the tests have indicated that Redelberta and Summercrest might fill the gap until Early Elberta and Elberta are ready to harvest.

All varieties under test ripening later than Elberta have not yielded satisfactorily, appeared to be lacking in quality, and are subject to heavy infestation by the Oriental peach moth.

Peach Maturity and Packages

Complaints made known in Ottawa, Montreal and Toronto indicated that the Ontario consumer was dissatisfied with the quality of Ontario-grown peaches and opposed the type of package used because of the deceptive red cloth cover. In 1943 excellent reports were obtained on shipments of peaches made from Harrow in flat-top 11-quart baskets to points as far distant as Ottawa, Timmins and Hearst. Experiments have been carried on since, using several types of closed cartons containing peaches of advanced maturity, in an effort to find a container acceptable to the grower, the shipper and retail trade. Although little progress has been made, a better understanding of the problem has been acquired which will be of assistance in future work.

Southwest Injury of Apples

A form of winter injury of apple trees known as sunscald or southwest injury is frequently found in orchards growing on sandy loam or gravelly soils in the district adjacent to Harrow. A severely affected orchard was located in

Figure 13.—SOUTHWEST INJURY OF APPLES

Healthy apple tree is shown on left in contrast to tree with slight injury on right and severe injury to tree shown in Figure 13A.

1937 and a careful tree-by-tree survey was made to determine if any varietal resistance to this form of winter injury could be found. Ten popular varieties were available for comparison and two degrees of injury, slight and severe, were used in classifying varieties.

The survey disclosed that the fifteen-acre orchard was planted on a level apparently uniform deep gravel soil (Burford) but definite areas where the injury was more severe existed regardless of variety, type of intercrop, companion crop or degree of neglect. The performance of varieties in the predominately injured areas offered a fair varietal comparison and the following information was obtained.

FIGURE 13A.—Apple tree showing severe Southwest Injury in contrast to slight injury shown in Figure 13.

Rhode Island Greening was found to possess some resistance as compared with Red Delicious, Golden Delicious, King David and Spy of which 50 per cent of the trees were severely injured. McIntosh, Ontario, Melba, Fameuse and Wagener, however, demonstrated little or no resistance. Golden Delicious, McIntosh and Melba were also severely affected by southwest injury in the typically healthy areas. The tree habit of the variety, severity of pruning and the cultural system followed were in no way correlated with the degree of injury and the survey did not indicate how this type of injury might be overcome in the future. The affected trees were bridge-grafted as soon as possible and a large proportion of the trees saved.

POLLINATION OF THE SPY APPLE

A survey made of an orchard consisting of 500 Spy trees twenty-three years old, from which a commercial crop had never been harvested in spite of heavy annual show of bloom, indicated a pollination problem. A few trees of Baldwin, Rhode Island Greening, Tompkins King, McIntosh, Snow and Tolman Sweet had been interplanted amongst the Spy trees with varying effects. Pollination trials carried out in 1938 using the pollen of Spy, Baldwin, Ben Davis, Red

Delicious, R.I. Greening, King, McIntosh, Snow, Tolman Sweet, Wagener and Wealthy on the Spy blossoms showed that only Delicious, Ben Davis, Wealthy and Tolman Sweet pollen produced a commercial set of fruit on Spy. As Spy often begins to bloom when most other varieties have passed full bloom it is necessary to select varieties for pollination which will overlap with Spy. In this respect Tolman Sweet and Ben Davis were found to be ideal but Delicious, Wealthy and McIntosh could not be considered absolutely reliable.

Apricot Variety Testing

The growing of apricots in southwestern Ontario is not recommended for several reasons. The tree is quite hardy and grows vigorously on any well drained sandy soil but the blossom and developing fruits of the desirable varieties are not resistant to early and late spring frosts. In addition, tree yields have not been comparable with yields obtained from peach, apple or plum trees of the same age and the present market value of the fruit will not compensate for the lower yield.

Raspberry Variety Testing

Red raspberries are grown in southwestern Ontario to some extent but in recent years picking difficulties and poor yields directly attributable to mosaic have created a lack of interest in this crop. In 1935 a collection of the standard varieties was planted on a Burford gravel soil. New varieties were added later to increase the collection to ten varieties made up of the following in order of ripening: Ohta, Chief, Brighton, Starlight, Viking, Newman, Herbert, Newburgh, Latham and Newman 20. Throughout the trials, these varieties ripened well in advance of similar varieties elsewhere in Ontario, but many factors contributed to poor yields and poor quality including mosaic, anthracnose, winter injury and insect attacks. In 1939 the trials were reduced in size and later discontinued but throughout the period 1936 to 1939 the following varieties were outstanding: Chief, Viking, Cuthbert and Latham.

Chief and Latham appeared to withstand mosaic, tolerated the hot dry summers, and suffered no noticeable winter injury regardless of snow cover. Viking and Cuthbert, however, were superior in quality of fruit but were more susceptible to attack by disease and winter injury.

Grape Variety Testing

Commercial grape production is only of minor importance in southwestern Ontario and no large wineries operate in the district. In 1935, however, a small collection of grape varieties was planted at Harrow on a Burford gravel soil with the purpose of finding varieties which might prove suitable for the basket trade. The varieties under test included, in order of ripening: Ontario, Portland, Campbell's Early, Moore's Early, Patricia, Fredonia, Worden, Barry, Brighton, Agawam, Herbert, Sheridan, Lindley and Niagara. In 1939 the test was discontinued.

All varieties ripened from two to three weeks in advance of the average date of ripening at the Vineland, Ont., Station, beginning with Ontario and Portland which matured in August and finishing with Niagara which ripened in the latter part of September. Of the varieties tested, the following are recommended for planting for the basket and roadside trade: Ontario (white), Portland (white), Patricia (blue), Fredonia (black), Worden (blue), Sheridan (black) and Niagara (white). Throughout the trials, grape berry moth and rose chafer required extra sprays to ensure clean attractive bunches of fruit.

VEGETABLES

L. F. OUNSWORTH[4]

TOMATO FERTILIZER EXPERIMENTS

The fertilizer experiments on the Earliana tomato, carried out during the early years of this period, included treatments with varying amounts of nitrogen, phosphoric acid and potash. These tests indicated that a commercial fertilizer relatively low in nitrogen, high in phosphoric acid and relatively high in potash was best suited for heavy production of early fruit in the Earlianna tomato. These fertilizer trials conducted previous to 1942 have little application in Essex county at the present time as the Bounty variety comprises about ninety per cent of the early crop.

In 1942, a fertilizer experiment was conducted using the Bounty variety. This variety produces a smaller plant which requires closer planting, hence the fertilizer needs would be different. A wide range of treatments was employed. The same experiment was continued in 1943. The highest yields of early fruit were obtained from an application of six hundred pounds of 2-17-0 mixture plus two side-dressings of nitrate of soda and muriate of potash (twenty pounds of nitrogen and thirty pounds per acre of potash per side-dressing). These were closely followed by the yields from an application of six hundred pounds of 2-12-10 plus four side-dressings of nitrate of soda (twenty pounds of nitrogen per side-dressing). It is now a recognized fact that the Bounty variety is a relatively heavy feeder and will utilize side-dressings of nitrogen to advantage.

TOMATO VARIETY EXPERIMENTS

Tomato variety trials were carried on through the period of this report. Experience has shown that varieties must be tested for a number of years to properly evaluate them. New varieties are being continually tested as the growers are always looking for a new and better variety.

Certain Ottawa varieties showed promise in 1937 but have been superseded by the Bounty and other newly introduced varieties which fit in with the cultural conditions and market requirements of this district. In 1942 and again in 1943, the Canadian Extra Early variety, a selection of Earliana, showed up to advantage in producing a large early yield. However, the growers do not care for this type of rough fruit. The Bounty was slightly later but seems to answer their needs at present. In 1945 and 1946, the Bounty variety proved to be the best early variety although Red Cloud and Valiant are being grown by some of the growers in the district.

OTHER TOMATO EXPERIMENTS

A number of experiments dealing with the propagation and culture of early tomatoes were conducted in 1942. The spacing experiment with the Bounty variety showed that a distance of one and a half feet between the plants in the row gave a greater early yield than even the two-foot spacing, with four feet between the rows. Allowing for the cost of the greater number of plants required for the closest spacing, the net returns justify using this method of growing plants. However, the two-foot spacing is the accepted practice in growing Bounty tomatoes.

The date of seeding and the method of handling early tomatoes were considered in an experiment where seed was sown on February 25, March 2, 16 and 30.

[4] Vegetable Specialist.

Plants from each of these seedings were grown in both four-inch pots and standard tomato trays. The March 16 seeding resulted in earlier yields than the earlier sowings owing to less root-binding taking place prior to the small plants being set in the field. These tests indicate that nothing will be gained by sowing early tomato seed earlier than the first week in March.

Plant protectors were tried in order to determine how much earlier plants could be set out without being harmed by frost. However, there was no frost after May 1 (the date the test was started) to test their effectiveness. It was found, however, that plants set out on May 22, unprotected, produced earlier fruit than those set out earlier and protected.

Tomato Breeding

A tomato breeding program was started in 1942. Although war service interrupted this project, it was resumed in 1946 when a number of breeding stocks were obtained from South Carolina. Many crosses were made, using disease-resistant stock and commercial varieties. The aim is to produce varieties more suitable to this district and which possess disease resistance. The possibility of obtaining a suitable hybrid is also being considered.

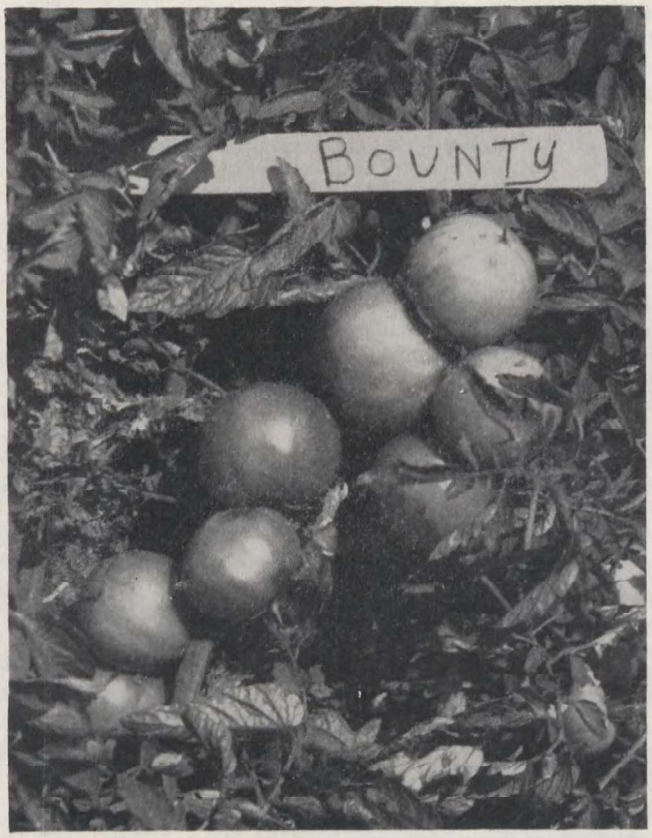

Figure 14.—A FRUIT CLUSTER ON A TYPICAL PLANT OF THE EARLY TOMATO VARIETY "BOUNTY"

Rotation Experiment

An experiment was initiated in 1946 to study the effect of rotation in vegetable crops, using tomatoes, potatoes and melons. A study of the effect of maintaining or improving the organic matter of the soil is included in this test. The cover crop of rye, following the vegetables, is fertilized in different ways to influence the growth of rye and, consequently, the amount of green manure returned to the soil.

Melon Variety Experiment

A melon variety experiment was undertaken to compare varieties for their suitability to this district. Such locally grown varieties as Perfection and Hoodoo have proved to be the earliest at Harrow. Fusarium wilt has been increasing in this district. Many varieties are susceptible to the wilt and early wilt-resistant varieties which will ship well are required.

Melon Breeding

A melon breeding program was started in 1942 but was interrupted during the war and resumed in 1946. A number of crosses were made between wilt-resistant strains and local early commercial varieties to introduce the resistance to wilt and maintain or increase the earliness. The possibility of producing a hybrid resistant melon is being kept in mind to act as a stop-gap until a suitable resistant variety is developed.

Figure 15.—(Left) EARLY MELON VARIETY TEST PLOTS AT HARROW
Figure 16.—(Right) THE EARLY MELON VARIETY PERFECTION

Asparagus Fertilizer Experiment

A fertilizer experiment on asparagus was undertaken in 1931. The treatments included different rates of applying nitrogen, phosphoric acid and potash; applications with and without commercial fertilizer; and nitrogen applications on manure treated plots. All treatments were replicated on sandy loam soil. The experiment was discontinued in 1940.

The use of 60 pounds of nitrogen per acre increased both the yield and the size of spears over lower applications. Potash was also instrumental in increasing the yield and size of spears, although not as much as nitrogen. Ninety-six pounds of potash gave the best results. Phosphorus appears to be the important element in the production of the crop, however, 64 pounds of phosphoric acid gave good results.

Manure and commercial fertilizer were combined to advantage. The addition of five tons of manure plus 1,000 pounds of a 6-6-10 fertilizer increased the yield and size of spears, particularly in the dry year of 1936. The highest yield and largest size of spear was obtained from an application of 20 tons of manure per acre, which treatment was closely followed by 10 tons of manure plus 400 pounds of nitrate of soda. Since such good results were obtained by incorporating organic matter with the soil, it is suggested that the asparagus tops be disked into the soil instead of burning them as is customary. The time of applying nitrate of soda (whether in spring or in summer) seemed to have little effect on the subsequent growth of the crop.

2, 4-D TRIALS 1946

T. B. HARRISON[5]

APPLICATION OF 2, 4-D PRIOR TO PLANTING

The pre-planting trials in 1946, where the ammonium salt form of 2, 4-D was applied at the rate of two pounds per acre on the soil surface, indicated that good control of broad-leaved weeds could be obtained for a period up to five weeks without causing any apparent damage to oats, flax and sweet corn seeded on the treated area. Grasses became very objectionable on the treated plots, however. The residual effect of the 2, 4-D on sensitive plants such as the snap bean and sweet clover had disappeared within a month after applying the 2, 4-D.

2, 4-D ON LAWN WEEDS

Several commercial forms of 2,4-D (sodium ammonium and amine salts) were used at the rate of 1 pound 2,4-D per acre on an established lawn in the spring of 1946 to kill dandelions and plantains and good control was obtained. It was found that 2,4-D could be safely applied to new lawns at the above rate any time after the lawn was two months old.

2,4-D ON BINDWEED AND CANADA THISTLE

The spot application of 2,4-D (amine salt) at the rate of 1 pound per acre in a field of hybrid corn to control Canada thistle and bindweed resulted in excellent control of Canada thistle after two applications and satisfactory control of bindweed after three applications of 2, 4-D at month intervals beginning in June. No apparent damage was done to the hybrid corn by the amine salt form of 2, 4-D although its use is not yet recommended in corn except in spot applications.

Cereal Crops

B. S. HOEGSTEDT[6]

WINTER WHEAT

For many years new varieties and strains of winter wheat developed in Canada and the United States have been tested along with standard varieties at Harrow. The winter wheat improvement work at Harrow was expanded in 1943 to include the selecting of resistant strains from segregating populations and the multiplications of new lines in a co-operative breeding program with the Cereal Division at Ottawa. In 1944, the winter wheat testing program was

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[6] Assistant, Cereal Crops.

extended to several locations in Essex and Kent counties. 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 at Guelph.

The objectives in this winter wheat breeding and testing program are new, stiff-strawed, high-yielding varieties of both white and red winter wheat that are resistant to rust, loose smut and other diseases and that possess the desired quality for the soft wheat milling trade. Each year milling and flour tests are made on all varieties and strains under test.

Dawson's Golden Chaff ranked as the best soft white winter wheat in Ontario for many years. This variety is very susceptible to rust as well as loose smut, however, and will be replaced eventually by new resistant varieties.

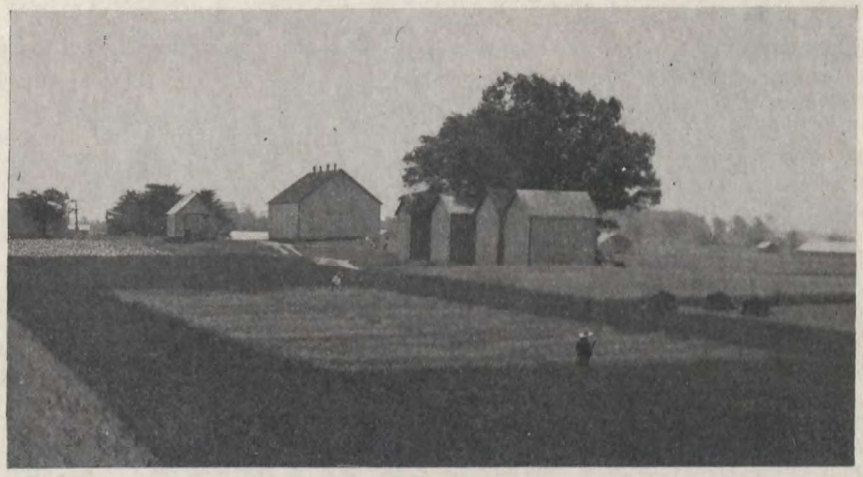

FIGURE 17.—A GENERAL VIEW OF THE WINTER WHEAT ROD-ROW TESTS AT HARROW

Among the white winter wheat varieties under test, Cornell 595 is a very soft wheat particularly suitable for pastry flour and has yielded well in three years of testing. This variety is also resistant to loose smut and is only moderately susceptible to rust.

The Ottawa selection No. 2619-A, resulting from crosses between Dawson's Golden Chaff and the spring wheat Ridit, has been the top yielder at Harrow over a period of six years. This strain is resistant to bunt and moderately resistant to leaf rust, and loose smut. It is also higher than Dawson's Golden Chaff in weight per bushel, protein content, and other flour strength properties but it is not as strong as the red wheat varieties. In spite of its other good qualities, the higher protein content makes the Ottawa selection less desirable as a soft wheat.

All red wheat varieties under test are too high in protein content to be properly classified as soft winter wheats. Except for blending purposes in the manufacture of crackers, the red winter wheat varieties are less desirable to the trade. The variety Fairfield, a red wheat introduced from the United States at the same time as Cornell 595, has also yielded well in three years of testing.

The average yielding ability of Cornell 595, Fairfield and Ottawa selection 2619-A are compared with Dawson's Golden Chaff in Table 9:—

TABLE 9.—AVERAGE YIELD OF FOUR VARIETIES OF WHEAT AT THE DOMINION EXPERIMENTAL STATION, HARROW, ONT.

Variety	6-year average	4-year average	3-year average
	bu.	bu.	bu.
Dawson's Golden Chaff	41·2	40·8	43·7
2619—A (Ottawa selection)	42·8	43·6	45·5
Cornell 595	.....	.....	44·4
Fairfield	.....	.....	46·3

Oats

The results of oat tests conducted at Harrow and at local points in Essex county over a period of years definitely established the fact that early-maturing oats outyield later-maturing varieties in this district. As a result the growers are now interested only in early oats.

For a number of years, Alaska was the standard variety in this district. During recent years, Ajax has become the leading variety, followed to some extent by Beaver and some of its sister strains. The principal weakness of the variety Alaska is its susceptibility to rust and its weak straw. Both Ajax and Beaver have stiffer straw than Alaska. A number of oat varieties recently developed in the United States have also been tested. Although most of these new introductions are not as uniform as Canadian productions, some of these varieties, and particularly Clinton, appear to have possibilities in Ontario.

Lodging of oats is frequently experienced on some of the more fertile soils of Essex and Kent counties with the result that the clover crop is damaged. The short-strawed variety Vicland, which is highly resistant to leaf rust, is recommended for these soils. While Vicland yields well on very fertile soils, it is not a good oat for soils low in fertility.

Poultry Husbandry

W. F. Mountain[7]

The ever increasing specialization in each of the many branches of the poultry industry during the period under review has wrought certain changes in poultry raising policies, and the opportunity also has been presented to combine innovations introduced through modern research with time-tested practices, to the general advantage of those associated with the industry. Although many problems have been eliminated and successful counter measures developed against others, many questions remain to be answered in the search for improvement that is vital to the industry in a national sense as well as that of the individual operator.

The investigations conducted on the Dominion Experimental Station at Harrow can be classed under the headings of breeding and feeding, although frequently, an analysis of the recorded data reveals other interesting and sometimes valuable facts equal in importance to that of the problem being investigated.

[7] Head Poultryman.

Breeding

Briefly, the basis of the breeding work conducted at Harrow has been to bring about a prepotency of high egg production in the Station flock, in combination with such characters as good egg size and body weight. The perpetuation of good breed type and freedom from standard defects is an ever present consideration. Vitality is also considered highly important in the breeding work being done.

In the selection of a bird as a breeder, her worth is gauged not only by the good traits she has displayed during her pullet year, but also by the value of her sisters. It has been proved that potential breeding value is measured by the performance of a family as a whole, rather than by individual accomplishment. In a like manner a very close scrutiny of the background of the male is

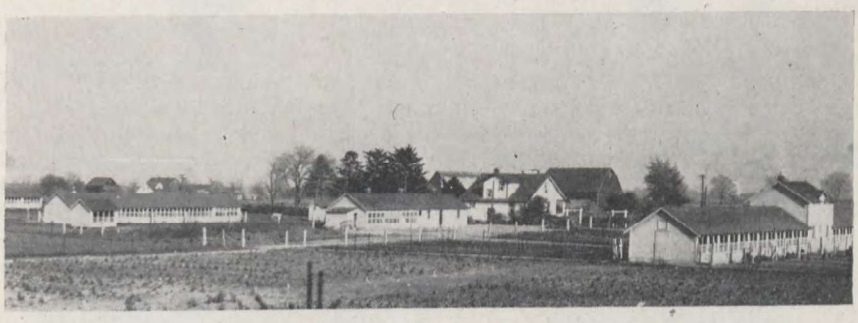

Figure 18.—VIEW OF POULTRY PLANT AT HARROW

essential as his influence is represented in each of his progeny to the extent of fifty per cent. With a complete knowledge of the family history at hand, the stock from tested lines which is distributed for breeding purposes, may be expected to exert a beneficial effect upon those flocks to which the birds are introduced.

Under the system of line breeding with an occasional close mating and selecting the breeders on a family basis, the greater part of the female progeny has shown a consistent repetition of high egg production in successive generations. An example is given in Chart I.

CHART I.—PERFORMANCE OF FIVE GENERATIONS OF SISTER GROUPS OF BARRED PLYMOUTH ROCKS ON THE DOMINION EXPERIMENTAL STATION, HARROW, ONTARIO

Hen	Egg Prod.	Hen	Egg Prod.	Hen	Egg Prod.	Hen	Egg Prod.	Hen	Egg Prod.
Q224	236	T133	278	W47	210	Y226	262	AA121	268
225	173	134	292	48	304	227	258	122	324
226	248	135	263	49	306	228	310	123	285
227	287	136	152	50	322	229	218	124	202
228	202	137	246	248	248			125	232
229	188							126	276
230	261							127	288
								128	316
								129	313
								130	299
								131	296
Great great grandam's sister group		Great grandam's sister group		Grandam's sister group		Dam's sister group		Daughter group	

The female progency of nine Barred Rock sires tested in 1946 repeated a general uniformity that has been present for some years past. The sire's daughter group with the lowest production averaged 234 eggs. The highest sire's daughter

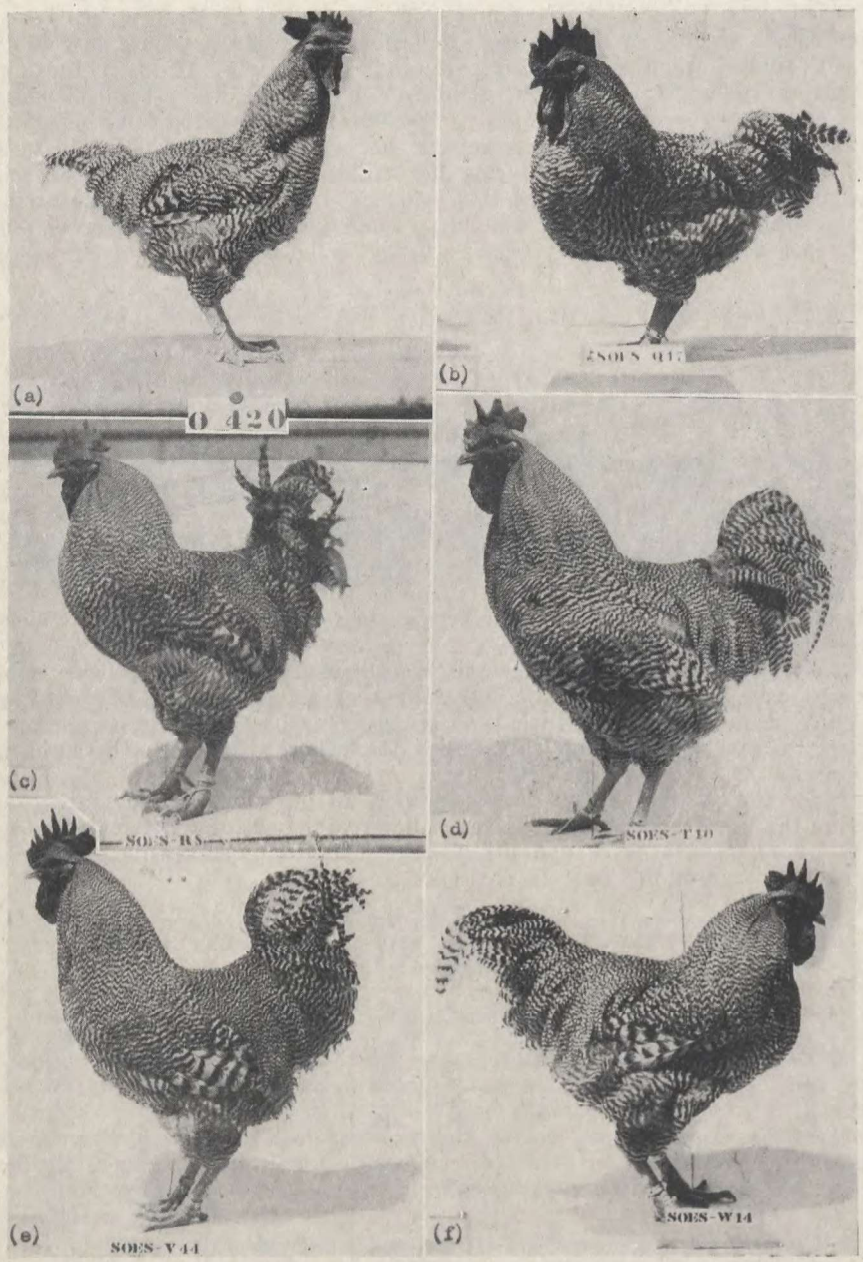

FIGURE 19.—SIX GENERATIONS OF MALES OF DIRECT LINEAGE

Improvement in type and colour with production of daughters maintained at a high level. (*a*) 0420, average production of daughters, 234 eggs; (*b*) Q17, son of 0420, average production of daughters, 255 eggs; (*c*) R8, son of Q17, average production of daughters, 259 eggs; (*d*) T10, son of R8, average production of daughters, 240 eggs; (*e*) V44, son of T10, average production of daughters, 249 eggs; (*f*) W14, son of V44, average production of daughters, 244 eggs.

group averaged 265 eggs. Produced out of a brother and sister mating, this last male was the only one alive of the six males on all Experimental Farms to pass the superiority standard for all locations. The possibility of prepotency of males out of such close mating is indicated, as a son of this male has daughters producing as high as any group now under test.

Feeding

Under modern methods of intensive poultry raising, with breeding and feeding practices aimed at the highest possible egg yields, certain conditions frequently arise to oppose the state of order that should exist in laying flocks. Feather picking and associated vices are rather common, and to ascertain the cause as well as to find the best methods to prevent feather picking, feeding experiments were undertaken at Harrow.

Preliminary work indicated that the addition of certain green food checked feather picking and, therefore, prompted further investigations into the values of various green feeds and methods of preparation. Several forms of greens were used, such as cabbage, beets, sprouted oats and alfalfa hay. Cabbage and beets showed little worth. Sprouted oats gave much better results although the cost and labour involved was considerable. Chopped alfalfa in a dry state afforded some protection but when chopped alfalfa was steeped for twelve hours the palatability was increased and complete freedom from feather pulling was demonstrated.

Comparisons over a number of years disclosed higher egg yields, larger eggs and better body weights in the groups that received the steeped alfalfa than in the pens that had no green food. Second cutting or better still, third cutting hay because of its finer stalk, is less wasteful than first cutting.

Fertility and hatchability tests of eggs laid by hens with and without green feed supplementing the ration revealed some significant points. The hatching power of eggs from layers fed steeped alfalfa was much better than where no

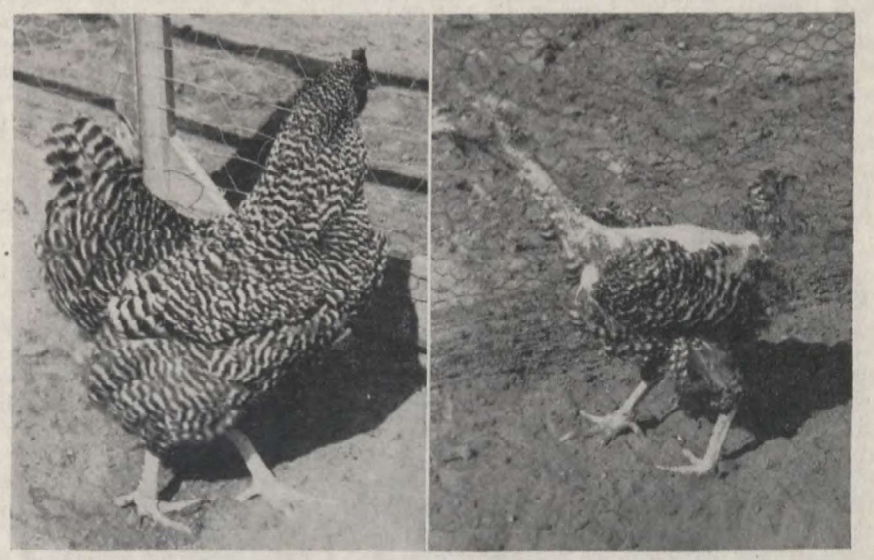

Figure 20.—CONTRASTS IN PLUMAGE

Left: Fed Alfalfa. Right: No Alfalfa.

Typical pullets from pens with and without chopped, soaked alfalfa hay supplementing the ration.

green food was fed. The chicks displayed greater vitality as well. Fertility did not seem to be affected as several tests over a period of three years gave fairly comparable numbers of fertile eggs whether the layers were fed alfalfa hay or not. The number of embryos that died between the eighth and eighteenth day was nearly three times as great in the groups where no green feed was supplied.

Housing

Under weather conditions of southwestern Ontario, the straw-loft cotton front-houses, 20 feet in depth, have rendered good service and are preferable to houses with less depth. Hinged at the top, the cotton screens allow easy adjustment of ventilation to the pens according to wind velocity and direction. They can be closed entirely to exclude rain or snow without obstructing the movement of fresh air completely.

Management

Under different periods of artificial light, better all-round performance was noted where the lighting was provided to make a 14-hour day. The lower egg production from birds under all-night lights could be attributed largely to the greater incidence of broodiness. From observation during the lighting investigations, the practice of closing the nests after the last eggs of the day have been collected has been found to be worthwhile in lessening the incidence of broodiness.

Young poultry reared on good pasture invariably develop more satisfactorily than when confined. Where circumstances preclude outside rearing, the value of steeped alfalfa added to the diet of birds in confinement was well demonstrated in 1946. Fed the same mash, one lot had access to alfalfa yards, the other lot was confined and fed chopped steeped alfalfa hay. No mortality occurred in either group during the four months of the test.

A three-year rotation of summer ranges, with cultivated crops in the intermediate seasons has proved to be a very satisfactory system on the Harrow Station. Stocked at the rate of around 600 pullets from six weeks of age to maturity, an acre of alfalfa pasture has accommodated the birds every third year without trouble being experienced. However, as a general rule, lesser numbers are advisable. The three-year rotation utilized at Harrow consists of tobacco the first year, oats and alfalfa the second year, and alfalfa for poultry pasture the third year.

Animal Husbandry

B. S. Hoegstedt[8]

Dairy Cattle

A small Jersey herd was established on the Harrow Station in 1935 starting with six foundation cows from the herd of B. H. Bull and Son, Brampton, Ont. Up to the time of writing the Jersey herd at Harrow has been limited in number to about twenty-five head. The herd is maintained under favourable conditions and is on pasture an average of one hundred and ninety days each year.

Emphasis is placed on home-grown feeds in the dairy ration and most of the feed used is produced on the Station. The protein is mainly supplied by such crops as soybeans, oats, corn, alfalfa hay and pasture. Soybeans have proved to be an excellent source of protein and now constitute fifteen per cent of the total meal mixture. Feeding trials at Harrow showed that production of both milk and butterfat were equal or better when ground soybeans replaced oilcake in the meal mixture.

[8] Assistant, Animal Husbandry.

Distribution of Breeding Stock

During the eleven-year period following the establishment of the herd, thirty-nine young bulls and twenty-eight females were sold for breeding purposes in southwestern Ontario. To prolong the usefulness of the herd sires, three of them have been leased to breeders in the district after each had completed two or three years service in the Station herd. One of the herd sires was later transferred to the Experimental Station at Nappan, Nova Scotia. A considerable number of new Jersey herds have been established in the district during this period and the distribution of breeding stock from Harrow has assisted in this development. At the present time, there are few Jersey herds in Essex county that do not possess some of the Station blood.

Record of Performance

All cows in the herd have been on test for production and eighty-two R.O.P. certificates have been received during the period of this report. In addition, three Honour Roll Certificates, two Gold Medal Certificates and eleven Silver Medal Certificates have been received for high producing cows in the herd. Two of the herd sires were issued Silver Medal Certificates and, in 1945, the herd sires, Harrow Design's Lord and Lennoxville Forward 9th, were raised in the advanced registry to Preferential One Star sires on the performance of their daughters.

Production figures in 1946 show that Harrow Forward Lady Cecile, a two-year old heifer, produced 9,943 pounds of milk and 578 pounds of butterfat in 365 days. The heifer Harrow Silent Dairymaid was awarded the "Jersey Roll of Honour" certificate in 1946 for being the highest in her class for butterfat production in Canada.

Three Proven Sires

The progress made in the Jersey herd at Harrow is shown by the proven sire indices obtained since the herd was established. Brampton Favorite Hal, the first herd sire, established a sire index of 9,684 pounds of milk with 5·14 per cent fat equalling 498 pounds of butterfat. The second herd sire, Harrow

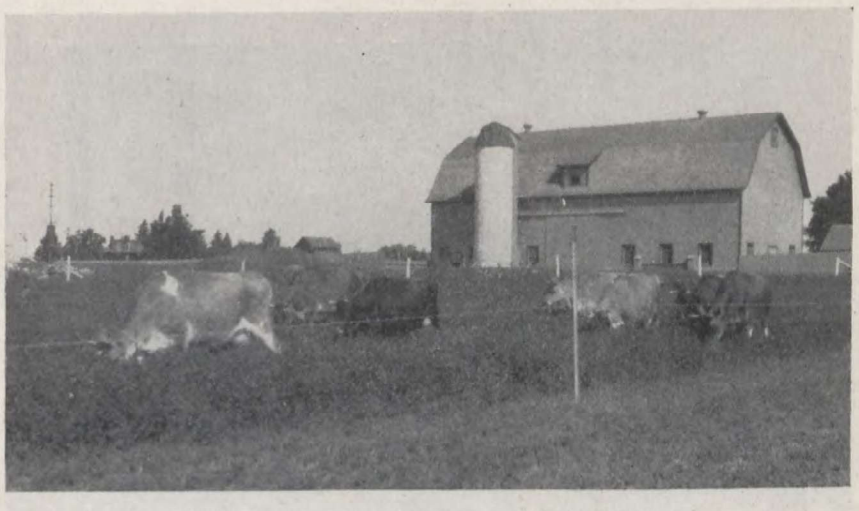

Figure 21.—PORTION OF THE JERSEY HERD ON SUMMER PASTURE
Pasturing hay crops in the rotation is usually necessary during the dry summer months.

Design's Lord, established a sire index of 13,801 pounds of milk with 4·82 per cent fat resulting in 665 pounds of butterfat. The third herd sire, Lennoxville Forward 9th, established a sire index of 10,527 pounds of milk with 6·34 per cent fat resulting in 667 pounds of butterfat. These figures show that production in the herd was maintained at a high level with the latter two sires.

The senior herd sire in 1946, Summerland Star of the West, was transferred as a calf from the Experimental Station at Summerland, B.C. His dam Summerland Lady Estelle holds the Canadian record for butterfat for all breeds of the same age. Calgarth Starlight, the world's champion Jersey cow for lifetime production, is found on both sides of the pedigree. The junior herd sire Green Hedge Volunteer is a grandson of the superior sire Broadview Sultan Volunteer and his dam is a Harrow-bred cow, Harrow Design Dot, a gold medal daughter of the proven sire Harrow Design's Lord.

Beef Cattle

Winter feeding of steers has been practised at Harrow for the past twenty years to utilize the surplus roughage and grain produced on the Station. During the period covered by this report, the steers have been fed on contract, with the feeder being paid a stipulated price for each pound of gain made during the feeding period. Some interesting data on winter feeding of steers are presented in Table 10. While these data indicate that surplus home-grown roughage and grain can be marketed through steers to advantage when the value of the manure is considered, the returns would have been greater had these steers been owned by the feeder.

In these trials, twenty steers were in the dry feed lot for a period of about 180 days. They were fed all the alfalfa and mixed hay they would consume and up to twenty-two pounds of corn per day, per steer, during the latter part of the feeding period. The corn was fed sparingly at the start and gradually increased to full feeding as soon as the steers were accustomed to the heavy feeding. Fresh water and salt were kept before the steers at all times. As not all feed was first grade, the charges made for feed in some cases may have been a bit higher than actual market value.

Figure 22.—WINTER FEEDING OF STEERS AT HARROW

TABLE 10.—WINTER FEEDING OF STEERS ON CONTRACT, 1936-1946, AT THE DOMINION EXPERIMENTAL STATION, HARROW, ONT

	1936-37	1937-38	1938-39	1939-40	1940-41	1941-42	1942-43	1943-44	1945-46
Number of steers	24	20	20	20	20	20	20	20	20
Starting weight per steer (lb.)	864·6	938·5	1·033·8	963·0	1,043·5	1,094	834·5	914·5	810·0
Finished weight per steer (lb.)	1,183·1	1,227·0	1,304·4	1,238·0	1,318·5	1,318	1,128·5	1,182·0	1,135·5
Average gain per steer (lb.)	318·5	288·5	270·7	275·0	275·0	224	294·0	267·5	325·5
Average gain per steer per day (lb.)	1·88	1·48	1·68	1·56	1·42	1·45	1·58	1·63	1·82
Feeding period (days)	169	183	161	176	193	154	186	164	179
Total gain on steers (lb.)	7,645	5,770	5,413	5,500	5,500	4,480	5,880	5,350	6,510
Return on steers ($) *	611.60	490.45	460.11	467.50	467.50	417.60	705.60	709.00	976.50
Value of manure ($)	400.00	300.00	216.00	236.00	260.00	208.00	400.00	352.00	375.00
Total returns ($)	1,011.60	790.45	676.11	703.50	727.50	625.60	1,105.60	1,061.00	1,351.50
Total cost of feed ($)	756.30	640.71	593.25	635.37	684.08	660.09	929.56	941.09	1·190.47
Gross returns over feed cost including manure ($)	Gain 255.30	Gain 149.74	Gain 82.86	Gain 68.13	Gain 43.42	Loss 34.49	Gain 176.04	Gain 119.91	Gain 161.03
Gross return per steer ($)	10·64	7·49	4.14	3.41	2.17	1.77	8.80	6.00	8.05

* Return on steers=contract price × total gain on steers.
NOTE: no steers were fed during winter of 1944-45.

The information gained from feeding steers at Harrow shows that feeder pigs (100 pounds or over) will fatten following the steers at no extra cost, resulting in a larger gross profit from the feeding operations. When the steers are on heavy feed, fifteen feeder pigs will follow twenty steers to good advantage. The daily gain is ordinarily higher at the end of the feeding period when the weather is warmer and the feeding period should extend over a period of at least 180 days for best returns. An average gain of 300 pounds or more per steer during a feeding period of six months is considered satisfactory and heavy feeding must be practised to accomplish such a gain. Approximately eight tons per steer of rich barnyard manure will be realized from such feeding practice. Gross profits realized from fattening steers may be determined by a number of factors among which are the condition and breeding of the steers fed, the price of feed in relation to the price of beef, the rate of feeding, the length of the feeding period, and the value placed on the manure produced.

Meteorological Records

W. A. Scott[9]

Daily meteorological records have been kept since 1918 on temperatures (maximum and minimum), rainfall, snowfall and sunshine. Fairly complete equipment was installed at Harrow in 1935 and since then weather observations have also included soil temperatures at depths of 4, 8 and 24 inches, grass minimum temperatures, relative humidity as recorded on the hygrograph and also by the wet and dry bulb method, daily evaporation, radiation of heat from the sun, in addition to sight observations on visibility and on wind direction and velocity.

Located in the most southerly county in the Dominion, the Harrow Station is approximately three miles from the north shore of Lake Erie. The extreme southwestern portion of Ontario is favoured with a relatively mild climate. Both climate and soils are particularly well suited to the production

[9] Assistant Tobacco.

TABLE 11.—MONTHLY AND ANNUAL AVERAGE WEATHER DATA INDICATING TEMPERATURES, PRECIPITATION AND HOURS OF SUNSHINE AT THE DOMINION EXPERIMENTAL STATION, HARROW, ONT., 1918-1946 (29 YEARS)*

Month	Temperatures F.°			Precipitation inches			Sunshine hours Average
	Mean Maximum Average	Mean Minimum Average	Mean Average	Rain Average	Snow Average	Total Average	
January	32·0	18·0	25·0	·95	10·14	1·96	79·41
February	35·0	19·6	27·3	1·12	8·44	1·97	94·99
March	43·8	27·3	35·6	1·92	3·98	2·32	124·58
April	55·6	35·6	45·7	2·36	1·77	2·54	168·13
May	68·0	46·5	57·2	2·41	·10	2·42	240·61
June	78·8	57·5	68·2	2·98	.....	2·98	256·69
July	83·5	62·1	72·8	2·21	.....	2·21	298·61
August	81·2	59·7	70·4	2·07	.....	2·07	262·62
September	74·3	54·0	64·1	2·52	.....	2·52	188·92
October	62·1	43·1	52·6	1·95	·09	1·95	156·10
November	47·1	33·0	40·0	1·41	3·08	1·72	91·62
December	35·3	22·7	29·0	1·12	7·91	1·91	62·47
Annual total or mean	58·1	39·9	49·0	23·02	35·51	26·57	2024·75

* Meteorological records taken in co-operation with Meteorological Division of the Department of Transport.

TABLE 12.—MONTHLY PRECIPITATION AT THE DOMINION EXPERIMENTAL STATION, HARROW, ONT, 1937-1946 (10 YEARS)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1937	5·38	1·49	0·82	5·04	2·46	6·74	4·31	2·97	2·32	3·44	1·67	2·44	39·08
1938	1·26	5·25	4·28	3·07	4·15	3·40	4·00	0·58	4·06	1·08	2·09	2·80	36·02
1939	3·16	4·58	1·61	4·09	2·12	2·98	4·92	1·54	1·54	1·60	0·44	0·94	29·52
1940	1·55	2·37	2·21	2·36	2·48	5·79	3·96	5·16	1·56	2·16	1·73	3·06	34·39
1941	1·91	0·82	1·46	1·32	2·82	4·53	2·32	3·54	1·74	4·42	1·41	1·59	27·88
1942	2·32	3·16	1·84	1·32	4·41	2·69	3·61	2·71	2·18	2·51	2·99	2·26	32·00
1943	2·59	1·67	2·02	2·67	6·06	3·50	4·26	0·72	1·34	1·39	1·78	0·65	28·65
1944	1·44	2·32	3·00	2·77	1·81	2·15	1·83	1·85	1·80	0·02	1·39	2·40	22·78
1945	1·37	1·92	3·68	2·39	4·20	5·15	1·87	1·37	5·77	3·23	1·01	1·55	33·51
1946	1·40	1·60	2·09	0·47	3·16	2·19	0·55	1·52	0·69	2·08	1·13	1·75	18·63
29-year average	1·96	1·97	2·32	2·54	2·42	2·98	2·21	2·07	2·52	1·95	1·72	1·91	26·56

Precipitation expressed in inches.

TABLE 13.—MONTHLY HOURS OF SUNSHINE AT THE DOMINION EXPERIMENTAL STATION, HARROW, ONT. 1937-1946 (10 YEARS)

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1937	78·2	99·8	148·0	149·7	231·8	207·0	280·5	272·8	206·7	119·9	107·0	57·6	1,959·0
1938	50·5	56·9	156·8	175·3	228·3	258·4	277·8	298·3	156·4	192·8	131·9	46·3	2,029·7
1939	63·5	112·6	109·2	136·6	285·3	239·2	312·8	287·2	207·7	168·2	114·4	46·6	2,083·3
1940	55·5	78·8	104·6	164·6	201·4	154·3	284·8	233·7	173·3	133·4	80·6	59·1	1,724·1
1941	38·2	103·9	143·7	222·5	292·5	244·7	317·4	293·3	222·5	115·7	105·9	69·4	2,169·7
1942	81·7	100·9	91·0	206·0	184·6	225·4	296·6	233·4	191·4	138·5	81·1	50·4	1,881·0
1943	56·9	110·8	136·9	162·9	146·6	283·9	275·2	242·0	215·3	142·0	81·5	111·6	1,965·6
1944	76·3	83·4	109·6	122·0	222·3	261·7	306·5	289·3	225·9	184·6	45·7	52·5	1,979·8
1945	66·1	58·3	156·5	181·2	206·7	203·3	290·2	268·5	165·7	165·2	56·0	75·1	1,892·8
1946	99·2	83·9	145·4	181·6	202·3	230·9	313·7	253·0	206·6	159·6	95·0	69·1	2,040·3
29-year average	79·4	95·0	124·6	168·1	240·6	256·7	298·6	262·6	188·9	156·1	91·6	62·5	2,024·7

of a great number of crops, a few of the more important ones being early vegetables, fruits, canning crops, tobacco, husking corn, soybeans, sugar beets and winter wheat. Extremes in temperature are seldom experienced at Harrow either in summer or winter. The temperature ranges from a mean maximum of 83·5 degrees for July to a mean minimum of 18·0 degrees in January. Precipitation is relatively low and the humidity is relatively high in the Harrow

TABLE 14.—MEAN MONTHLY TEMPERATURES AT THE DOMINION EXPERIMENTAL STATION, HARROW, ONT. 1937-1946 (10 YEARS)

Year	January			February			March			April		
	Mean Max.	Mean Min.	Mean Av.	Mean Max.	Mean Min.	Mean Av.	Mean Max.	Mean Min.	Mean Av.	Mean Max.	Mean Min.	Mean Av.
1937	35·7	22·3	29·0	35·3	21·6	28·4	39·0	23·9	31·4	54·3	35·6	44·9
1938	32·5	18·3	25·4	39·4	24·4	31·9	50·2	32·0	41·1	56·4	38·4	47·4
1939	35·8	20·7	28·2	35·9	19·1	27·5	42·0	26·3	34·2	52·9	35·2	44·0
1940	23·9	13·3	18·6	32·9	21·7	27·3	34·5	24·3	29·4	51·4	33·6	42·5
1941	32·6	21·8	27·2	31·5	19·9	25·7	39·1	23·5	31·3	62·8	39·6	51·2
1942	33·3	19·8	26·5	30·0	17·1	23·6	45·3	31·3	38·3	64·3	39·9	52·1
1943	29·5	16·6	23·0	37·5	21·7	29·6	43·0	24·5	33·7	52·6	28·5	40·6
1944	38·6	23·3	30·9	37·1	21·4	29·3	39·0	24·8	31·9	52·2	34·0	43·1
1945	25·3	9·4	17·4	34·2	20·7	27·4	57·9	35·4	46·7	62·0	41·2	51·6
1946	35·9	21·5	28·7	36·8	20·3	28·5	57·1	35·8	46·4	59·9	37·0	48·4
29-year average	32·0	18·0	25·0	35·0	19·6	27·3	43·8	27·3	35·6	55·6	35·6	45·6

Year	May			June			July			August		
	Mean Max.	Mean Min.	Mean Av.	Mean Max.	Mean Min.	Mean Av.	Mean Max.	Mean Min.	Mean Av.	Mean Max.	Mean Min.	Mean Av.
1937	68·1	47·2	57·7	76·0	57·6	66·8	81·8	62·4	72·1	82·7	63·0	72·9
1938	68·3	47·6	57·9	77·7	56·7	67·2	82·8	62·8	72·8	72·9	63·8	68·4
1939	71·8	49·9	60·9	79·8	61·7	70·8	83·4	63·0	73·2	80·9	63·0	71·9
1940	65·8	47·3	56·6	77·3	59·3	68·3	82·5	62·4	72·5	78·4	62·3	70·4
1941	74·1	50·3	62·2	70·5	59·7	69·6	83·6	63·3	73·5	81·4	59·2	70·3
1942	71·0	49·8	60·4	79·0	58·6	68·8	84·4	62·6	73·5	78·8	60·7	69·7
1943	65·5	47·2	56·3	82·8	62·1	72·4	83·1	62·4	72·7	82·2	62·1	72·1
1944	74·0	52·0	63·0	83·6	61·1	72·3	87·0	60·7	73·8	86·4	63·1	74·7
1945	63·2	43·4	53·3	75·4	54·9	65·2	81·6	60·2	70·9	83·8	60·3	72·0
1946	67·7	46·9	57·3	78·5	57·0	67·7	86·9	61·0	73·9	80·3	56·8	68·6
29-year average	68·0	46·5	57·2	78·8	57·3	68·2	83·5	62·1	72·8	81·2	59·7	70·4

Year	September			October			November			December		
	Mean Max.	Mean Min.	Mean Av.	Mean Max.	Mean Min.	Mean Av.	Mean Max.	Mean Min.	Mean Av.	Mean Max.	Mean Min.	Mean Av.
1937	72·4	51·3	61·9	57·2	41·2	49·2	44·8	31·2	38·0	31·7	20·3	26·0
1938	72·1	53·5	62·8	65·6	42·4	54·0	50·0	32·6	41·3	36·2	23·5	29·8
1939	78·8	56·7	67·7	63·8	44·7	54·2	46·2	32·1	39·1	39·6	29·2	34·4
1940	71·9	52·4	62·2	62·4	43·8	53·1	46·0	32·2	39·1	38·4	27·2	32·8
1941	78·2	56·4	67·3	64·2	47·7	56·0	49·2	35·9	42·6	41·2	30·0	35·6
1942	74·4	52·4	63·4	62·7	44·6	53·7	48·3	34·2	41·3	30·6	19·4	25·0
1943	73·1	51·0	62·1	61·6	40·9	51·2	45·3	31·3	38·3	35·9	20·7	28·3
1944	77·5	54·5	66·0	65·2	42·0	53·6	49·4	36·5	42·9	31·5	18·6	25·0
1945	71·2	57·1	64·2	60·2	42·3	51·3	48·5	35·2	41·8	30·1	19·2	24·6
1946	78·8	54·9	66·8	70·8	47·3	59·1	51·9	36·6	44·2	39·8	24·9	32·4
29-year average	74·3	54·0	64·1	62·1	43·1	52·4	47·1	33·0	40·0	35·3	22·7	29·0

district. The total average annual precipitation over a period of twenty-nine years is 26·56 inches and the average annual total sunshine is 2024·7 hours. The average frost-free period expectancy is 159 days at Harrow.

Table 11 presents information on the average weather conditions at Harrow based on data gathered over a period of twenty-nine years.

A detailed record of precipitation by months and years throughout the ten-year period 1937 to 1946 is given in Table 12. A detailed record of the total hours of sunshine by months and years for the same period is given in Table 13. During the ten-year period 1937 to 1946 the annual precipitation decreased erratically from the wettest year on record 1937 with 39·08 inches to one of the driest years 1946 with 18·63 inches. Nevertheless, in all but two years—1944 and 1946—total precipitation was above average. The total hours of sunshine plotted against total annual precipitation shows a remarkably uniform inverse relationship between sunshine and precipitation. In the ten-year period there was less sunshine than average during six years, approximately average amounts during two, and more than average in two years.

Mean maximum, mean minimum and mean average temperatures by months for the ten-year period are shown in Table 14. Noteworthy deviations from average in this table are the severe winters indicated by the mean minimum in January 1940, 13·3 degrees, and 1945 with 9·4 degrees. Also outstanding are the higher mean maximum temperatures appearing periodically throughout the latter part of the period as follows: June 1943, 82·8 degrees, June and July 1944, with 83·6 and 87·0 degrees respectively, and the generally higher temperatures throughout March of 1945, and March, July, September and October of 1946. These higher than average temperatures undoubtedly bear a relationship to the drier weather of the latter part of the ten-year period.

Table 15 gives complete details of last spring frost, first fall frosts and frost-free periods for ten years 1937 to 1946. Cropping practices were not hampered in any of the years by unseasonal frosts or short frost-free periods.

TABLE 15.—THE OCCURENCE OF FROST AND FROST-FREE PERIODS AT THE DOMINION EXPERIMENTAL STATION, HARROW, ONT. 1937-1946 (10 YEARS.)
(FREEZING TEMPERATURE 32 DEGREES F. OR LOWER)

Year	Last Spring Frost	First Fall Frost	Frost-free Period
1937	April 16	October 13	179
1938	May 13	October 28	168
1939	May 12	October 13	154
1940	April 27	October 16	172
1941	May 11	October 28	169
1942	April 22	September 28	159
1943	May 1	October 5	157
1944	April 29	October 15	169
1945	May 11	October 15	157
1946	May 13	November 15	186
29- year average	May 7	October 11	159

TABLE 16.—MONTHLY MEAN SOIL TEMPERATURES IN DEGREES FAHRENHEIT AT FOUR INCH, EIGHT INCH AND 24 INCH DEPTHS. (1937-46). DOMINION EXPERIMENTAL STATION, HARROW, ONT.

	January	February	March	April			May			June			July			August			September			October			November	December
	24"	24"	24"	4"	8"	24"	4"	8"	24"	4"	8"	24"	4"	8"	24"	4"	8"	24"	4"	8"	24"	4"	8"	24"	24"	24"
1937	35	33	34	43	44	43	60	58	55	72	70	68	78	76	74	79	78	75	67	68	68	51	52	54	43	33
1938	31	32	39	50	49	48	61	60	58	74	71	68	80	72	74	81	80	77	67	67	68	57	56	58	47	37
1939	35	34	35	46	46	43	65	59	60	74	73	70	79	78	75	77	76	75	71	70	70	56	57	58	44	39
1940	30	30	32	42	41	39	57	56	54	71	70	67	75	76	72	75	75	73	66	66	67	54	55	57	44	37
1941	35	33	33	49	50	48	64	63	61	69	68	68	74	74	74	75	74	74	70	70	70	57	58	59	45	40
1942	33	33	35	51	50	48	61	60	59	71	70	68	77	76	74	72	72	72	65	67	68	54	55	56	46	36
1943	34	34	36	44	43	45	55	55	53	74	72	69	74	74	73	74	75	74	65	65	66	54	54	56	44	36
1944	32	33	34	43	42	42	64	62	59	74	72	71	78	77	76	77	77	76	70	70	70	55	56	58	47	37
1945	35	34	42	51	52	52	54	54	52	66	66	64	74	74	73	75	75	74	69	70	67	52	50	51	46	37
1946	35	33	41	51	51	50	59	59	57	69	68	66	81	82	76	73	73	72	70	70	68	60	60	60	49	38
Average 12 years	33	32	36	47	47	45	60	59	57	71	70	68	78	77	75	76	76	75	68	68	68	55	55	56	45	37

TABLE 17.—MONTHLY MEAN RELATIVE HUMIDITY. (1937-46) DOMINION EXPERIMENTAL STATION, HARROW, ONT.

	January	February	March	April	May	June	July	August	September	October	November	December
1937	79	71	73	75	73	75	72	76	69	76	78	82
1938	77	78	76	71	73	67	62	68	76	81	88	80
1939	80	80	80	74	71	82	68	77	71	74	78	79
1940	77	83	69	69	76	78	73	76	85	80	77	76
1941	77	76	75	68	62	72	69	68	70	80	81	78
1942	79	72	77	71	77	77	74	82	77	78	79	71
1943	79	77	71	75	80	75	76	76	75	76	78	70
1944	80	78	81	81	74	74	65	72	76	77	83	76
1945	80	76	77	75	74	80	76	73	77	61	80	85
1946	75	74	78	75	78	72	62	67	64	76	80	72
Average 12 years	79·3	77·3	75·8	73·2	73·3	75·3	69·3	73·2	74·2	76·0	80·3	77·7

TABLE 18—MONTHLY EVAPORATION MAY—OCTOBER (1937-46) DOMINION EXPERIMENTAL STATION, HARROW, ONT.

(MEASUREMENTS CUBIC CENTIMETERS)

	May	June	July	August	September	October
1937	111·9	112·5	134·8	98·9	134·9	90·4
1938	120·3	152·1	131·8	139·2	107·4	84·7
1939	123·9	127·2	176·8	125·7	136·0	110·2
1940	108·2	102·2	140·1	115·5	77·9	79·0
1941	173·3	113·3	121·5	136·1	114·1	72·8
1942	97·7	89·0	126·5	82·8	76·9	63·8
1943	68·7	98·6	87·9	97·4	80·5	72·7
1944	80·9	106·5	138·5	114·8	89·4	81·1
1945	73·9	63·5	99·5	102·7	78·5	63·5
1946	90·8	88·8	126·1	103·5	92·6	77·0
Average 12 years	108·19	108·19	136·23	116·17	101·25	79·68

TABLE 19.—MONTHLY MINIMUM TEMPERATURE ON THE GRASS (1937-46) DOMINION EXPERIMENTAL STATION, HARROW, ONT.

(DEGREES FAHRENHEIT)

	January	February	March	April	May	June	July	August	September	October	November	December
1937	−21·0	4·5	8·5	19·8	26·6	38·0	43·0	45·5	25·1	13·0	8·9	1·0
1938	−6·0	−3·0	8·0	9·0	16·5	36·0	46·0	44·0	32·0	21·0	3·5	1·0
1939	−13·0	−2·0	1·5	11·6	21·0	36·0	37·0	45·3	35·0	16·0	15·0	4·0
1940	−10·5	3·0	1·8	12·5	27·0	38·0	40·0	35·0	32·0	20·0	14·6	−3·0
1941	2·8	−2·0	7·0	18·6	21·5	36·0	43·0	37·5	33·6	20·6	17·0	4·6
1942	−13·0	−10·0	19·0	18·0	29·2	34·8	40·5	37·8	21·8	21·3	16·0	−9·0
1943	−10·0	−9·0	−14·0	10·2	24·6	38·5	42·0	40·0	27·2	22·6	10·0	−7·5
1944	−1·5	−1·5	7·8	12·8	31·8	39·5	42·8	41·5	28·0	17·2	16·0	−9·5
1945	−9·5	−4·0	9·0	17·6	24·6	30·5	35·0	42·8	33·0	21·5	14·7	−19·0
1946	−3·8	−2·0	15·0	16·5	24·0	40·5	39·0	38·3	34·0	26·5	16·0	5·0

List of Active Projects (1937-46)

Tobacco

T- 1	Tobacco seed-bed investigations
T- 7	Relation of climate to tobacco culture
T- 11	Studies on the stand and number of replantings
T- 12	Methods of planting tobacco
T- 15	Crop rotation for burley tobacco
T- 16	Time and methods of ploughing for tobacco
T- 18	Varietal tests of burley tobaccos
T- 21	Methods of applying fertilizers for tobacco
T- 22	Methods of harvesting tobacco
T- 24	Conditioning tobacco for handling
T- 26	Tobacco seed production
T- 27	Curing studies on tobacco
T- 30	The use of barnyard manure for tobacco
T- 41	Genetical and cytological studies on tobacco
T- 42	Field surveys of tobacco in Canada
T- 47	General tests of strains and selections
T- 57	Tobacco soil investigation
T- 58	Statistical and marketing studies on tobacco
T- 59	Studies on the effects of topping and suckering
T- 72	Crop effect studies on tobacco
T- 78	Black root-rot investigations on tobacco
T- 79	Brown root-rot investigations on tobacco
T- 87	Sources of nitrogen in tobacco fertilization
T- 88	Sources of potash in tobacco fertilization
T- 89	Sources of phosphoric acid in tobacco fertilization
T- 91	Quantitative studies on the nitrogen requirements of tobacco
T- 92	Quantitative studies on the potash requirements of tobacco
T- 93	Quanitative studies on the phosphoric acid requirements of tobacco
T- 94	Studies on magnesium and chlorine
T- 95	Varietal tests of dark tobacco
T- 98	Studies on the stripping and grading of tobacco
T- 99	Varietal tests on different types of soil
T-101	The fertilization of rye cover crops in the tobacco rotation
T-103	Cropping practices on tobacco
T-104	Fertilizer studies in relation to different cultural practices
T-106	Organic *vs.* water soluble nitrogen for tobacco
T-107	Illustration plots
T-108	Minor and trace elements for tobacco
T-110	Balance of nutrient elements on tobacco
T-111	Comparison of fertilizer formulae for tobacco
T-112	Fertilizers for dark tobacco

Forage Crops

Ag. 2	Indian corn. Variety test for production of grain.
Ag. 7	Indian corn. Breeding.
Ag. 77	Sunflowers. Plant breeding and selection.
Ag.117	Soybeans. Breeding.
Ag.181	Soybeans. Variety for forage and seed.
Ag.182	Soybeans. Methods of planting.

Horticultural Crops

H-815.1	Tree fruits variety experiment—peaches
H-815.2	Tree fruits variety experiment—apricots
H-924	Science orchard for entomological studies
H-948	Peach shipping experiment
H-836	Tree fruits, rootstock studies
H-777-K	Tree fruits, physiological investigations. Bitter pit of apples
H-785	Tree fruits, fertilization—apples and peaches
H-793	Bush fruits, variety experiment
H-388	Tomato, fertilizer experiment
H-791	Vegetable vine crops, breeding and selection
H-805	Vegetable vine crops, variety experiment
H-822	Solanaceous vegetables, breeding and selection
H-806	Solanaceous vegetables. Variety experiment
H-951	Vegetable rotation and organic matter experiment
H-604	Asparagus, fertilizer experiment
H-737	Asparagus, cultural experiments
H-637	Plant protectors for early vegetables
H-820	Vegetables, different dates of seeding or planting
H-879	Tomato, cultural experiments

Cereal Crops

CE–4	Winter wheat
CE–5	Oats

Poultry Husbandry

P 28	Rate of growth in rearing
P 56	Pedigree breeding for egg production
P 57	Relation of body weights to egg production
P 62	Costs of egg production
P 64	Egg laying contests
P 104	Effect of green feed upon hatchability and viability of chicks
P 108	Cost of feeding layers
P 166	Substitutes for fresh green feed
P 157	Improving quality of poultry in district
P 192	Influence of feed upon interior quality of eggs
P 223	The comparative influence of genetics and environment upon meat type, egg production

Animal Husbandry

A– 58	Record of performance (Dairy and dual purpose breeds)
A– 93	Tuberculosis Test
A–172, A–194	Winter feeding of steers
A–503	Breeding Jersey cattle
A–660	Serum test for contagious abortion
A–793	Linseed oilmeal versus soybeans as a protein supplement for dairy cattle
A–813	Feed cost of milk and butterfat production

Field Husbandry

F–305	Meteorological records
F–398	Manure versus commercial fertilizer for pasture

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