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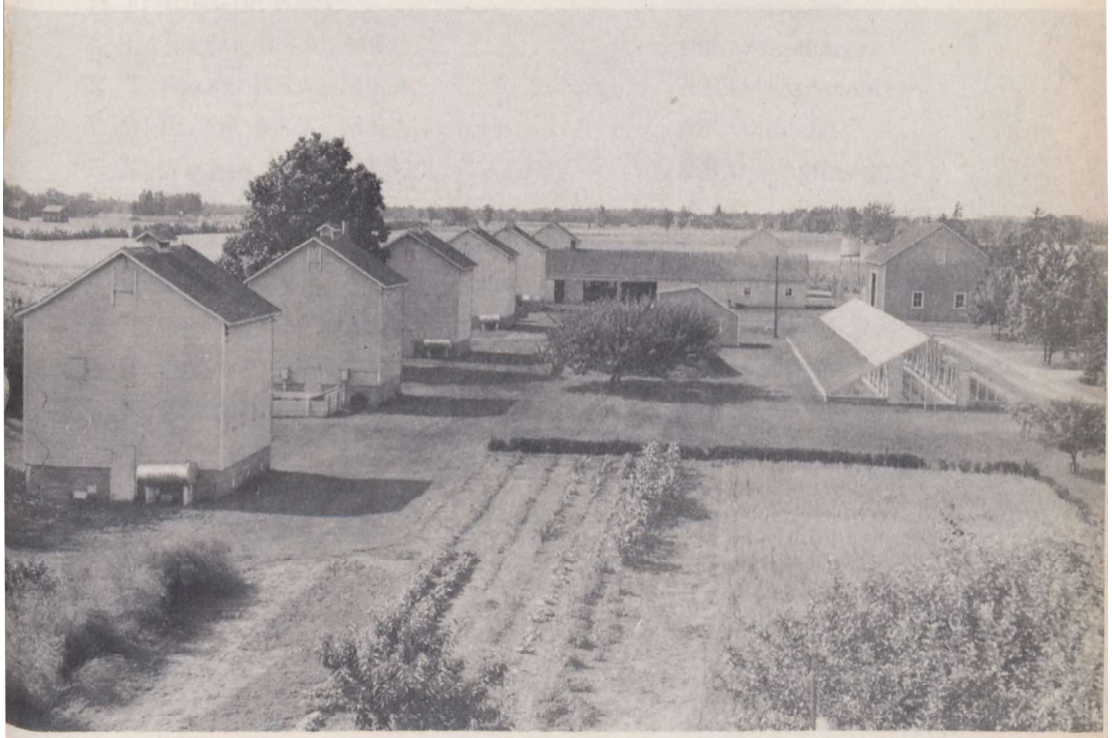
Canada

CANADA
DEPARTMENT OF AGRICULTURE
EXPERIMENTAL FARMS SERVICE

DOMINION EXPERIMENTAL SUBSTATION
DELHI, ONTARIO

L. S. VICKERY, B.S.A., M.Sc., OFFICER-IN-CHARGE

PROGRESS REPORT
1946-1952



View of the kilns, implement shed, greenhouse and pack barn at the Experimental Station, Delhi, Ont.

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DOMINION EXPERIMENTAL SUBSTATION
DELHI, ONTARIO

Technical Staff 1952

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INTRODUCTION

The last progress report, published in 1946, covered the period 1937-1945. The present report includes experimental work in progress during the period of the previous report as well as new work started since 1945. From 1934 to 1949 Dr. F. A. Stinson was Officer-in-charge, resigning in 1949 to head the Soils Department, Ontario Agricultural College, Guelph. Dr. Stinson was succeeded by L. S. Vickery. Since its establishment in 1933 the Substation has been under the supervision of H. F. Murwin, Superintendent, Harrow.

The Delhi Substation has concentrated solely on the production of flue-cured tobacco to meet the demands for experimental work in this rapidly developing industry. Over 72 per cent of all the flue-cured tobacco grown in Ontario lies within a 20-mile radius of Delhi. Since Delhi is centrally located in the tobacco growing areas it has become a highly specialized Substation. The Substation serves approximately 4,000 growers, most of whom visit the Substation for information during the course of each year. The acreage of flue-cured tobacco has increased from 30,042 acres in 1933 to 106,260 in 1951. In 1945 the acreage was 90,787 acres. The number of farmers using the Substation has increased from 3,136 in 1946 to 4,679 in 1952 indicating its importance in the district.

In recent years, experimental work has been devoted chiefly to varieties, crop rotations, rebuilding and maintaining the productivity of soils, studying improved methods of handling tobacco, and studying the quality of tobacco from various treatments through chemical and physical tests of the leaf tissue. Through improved varieties, fertilizers, rotations, and cultural practices, the average yield per acre has increased from 1,011 pounds for the period 1933-1937 to 1,231 pounds for 1946-1952.

This summarized report covers briefly recent developments in tobacco production, coupled with recommendations and up-to-date information on producing flue-cured tobacco in Ontario. It is impossible to cover all research work conducted since 1946. However, summaries and recommendations are given where feasible.

METEOROLOGICAL RECORDS

Weather and soil largely govern the successful production of flue-cured tobacco. In Ontario the climate is moderately mild during the growing season because of the surrounding Great Lakes—Erie, Ontario, Huron and St. Clair. Successful crops are largely dependent upon the amount of rainfall during certain periods of the growing season, and the length of the frost-free period. Tobacco is very susceptible to frost and hail damage. Frosts often occur after transplanting and in late summer, and hail usually in July and August.

Most of the flue-cured tobacco is grown on well-drained sandy to sandy loam soils between 42°30′ and 43°00′ north latitude where the average frost-free period is usually sufficient to permit maturity. Tobacco requires approximately 125 frost-free days from transplanting to the end of harvest.

Tobacco seedlings are started in unheated, glass-covered greenhouses for protection from cool weather and frosts until the latter part of May. Transplanting to the fields usually commences May 20 to 24, ending about the middle of June, with the majority of growers finishing by the first week of June. Harvesting is generally commenced the second week of August, and finished during the last two weeks of September. The type of soil, rainfall, sunshine, temperature, fertilization, varieties, and general management all influence the rate of maturity in tobacco.

The growing seasons since 1946 were favorable with the exception of 1947. The yields per acre were as follows: 1946—1,277 pounds, 1947—848; 1948—1,143; 1949—1,324; 1950—1,211; 1951—1,294 and according to the Dominion Bureau of Statistics the average yield for 1952 was 1,567 pounds per acre, giving an average of 1,237 pounds for the 7-year period, 1946-52.

Tobacco harvesting was late in 1946 because of cool cloudy weather during early August. Scarcely 10 per cent of the crop was harvested by August 24. Tobacco harvested before this date was immature and cured unevenly. Approximately eight million pounds of tobacco were destroyed by frosts occurring on September 2 and 3, but most of the remaining crop was harvested without difficulty.

The 1947 crop was affected by black root-rot disease as a result of the cool wet weather in late spring and early summer. All varieties grown at that time were susceptible to this disease. Lack of rain and extremely dry warm days during the first two weeks of August caused considerable damage to the crop. The sand leaves were practically destroyed on many crops and in some cases the second priming was badly rim-fired. The remainder of the crop received higher than average rainfall but generally the leaf lacked body.

In 1948 showers were frequent throughout May and June promoting rapid growth until the middle of July. Showers were more timely over other flue-cured districts than within the immediate vicinity of Delhi. A light frost occurred on August 31 over a small area in Simcoe county, while at Delhi the first killing frost occurred on October 17, too late to cause any damage. The loss from frost in 1948 was generally slight.

Several severe frosts caused considerable damage to the tobacco in the field during the 1949 transplanting season. Light frosts occurred on the nights of May 24, 25 and 26, and heavy frosts occurred on May 27 and June 7. Nearly half of the newly transplanted tobacco was destroyed in the district. The weather was exceptionally warm from June 11 to June 30, and little rainfall was received from June 22 to July 9. A dry period from July 27 to August 11 caused considerable damage to the bottom leaves. Curing was difficult for ten days after the dry period. Favorable weather during the remaining part of the growing season helped to produce good quality and weight.

The 1950 yield was lowered because of dry weather in August. Frost on September 16 destroyed approximately one million pounds of tobacco in the district. The minimum temperature at the Substation that night was 33·5°F. The quality of the 1950 crop was excellent, yielding 1,211 pounds per acre.

In 1951 a heavy frost destroyed over 3¼ million pounds on September 7. The heaviest damage occurred through the Walsh, St. Williams, Walsingham, and Cultus areas. In spite of the loss caused by frost, the crop yielded higher than normal and was fair in quality.

The 1952 crop was the heaviest ever produced in Ontario. Warm, dry weather during June and early July assisted in developing a deep root system that later supplied the plant with the necessary moisture and nutrients to produce a large, heavy-bodied crop. Some areas suffered a severe drought, but conditions generally were excellent. A severe wind and hail storm damaged approximately 700 acres of tobacco in the Waterford district on August 15. Frost also destroyed nearly one million pounds of tobacco on September 27.

Weather has considerable effect on the quality of flue-cured tobacco. Cool, wet, dull weather causes delayed maturity. High temperatures reduce the water content and favor strong aroma and thickening of the leaf. Optimum moisture conditions favor large, broad, thin, fine-veined, open-textured, elastic, light-colored, bright leaf with low nicotine content, weak aroma, and little resinous matter. Less favorable moisture conditions result in smaller, narrower, denser, heavier, thicker-veined, less elastic, darker colored, duller leaf with more nicotine, stronger aroma and more resin. In general, tobacco requires a rapid, uninterrupted growth season, somewhat limited rainfall during the ripening period, and not too much humidity throughout the curing season.

Tobacco may be damaged by frost when the official air temperature is 32°F., or slightly higher. The reason is that official meteorological temperatures are taken at a height of 4½ feet and the temperature at ground level may be several degrees different. Moreover temperatures fluctuate rapidly and independently of air temperatures. The temperature of a leaf in direct sunlight may become as high as 18°F. warmer than the air. The loss of heat from leaves to a clear sky at night accounts for frost injury when official temperatures do not fall to the freezing point. Temperatures recorded at ground level were found to drop an average of 6°F. below the official temperatures during the harvest season in 1952. Readings at ground level on the grass may be more comparable with frost injury than are official readings taken 4½ feet above ground level.

TABLE 1.—PRECIPITATION RECORDS

(Monthly and Annual Precipitation Records (inches) 1946-52, inclusive, with 18-year averages and monthly extremes for the same period)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total annual snowfall (in.)	Total annual rainfall (in.)	Total annual precipitation (in.)
1946	1·35	3·33	2·47	·65	3·08	2·69	1·89	2·53	2·50	3·69	2·95	4·11	36·79	27·51	31·19
1947	3·34	2·28	3·89	6·05	4·70	5·10	4·65	2·03	4·41	·58	1·66	2·76	91·50	32·28	41·43
1948	1·90	2·91	4·83	3·80	4·11	3·78	1·33	1·19	1·41	2·67	4·18	3·40	43·99	31·11	35·51
1949	3·65	3·50	2·91	2·01	3·15	1·14	3·73	3·04	4·32	3·11	2·68	5·99	39·75	35·23	39·21
1950	6·76	3·28	2·44	3·10	1·23	2·60	4·42	3·87	1·49	2·60	6·10	2·87	65·85	34·13	40·72
1951	2·62	3·20	2·33	5·14	2·94	3·07	4·09	1·95	2·84	3·41	4·26	5·54	73·01	35·39	42·69
1952	3·94	2·80	3·41	3·27	3·30	1·09	3·23	5·56	4·60	1·18	2·44	3·42	49·50	33·49	38·44
18-year average	3·07	3·12	3·11	3·38	3·40	3·14	3·40	2·81	3·27	2·71	3·04	3·14	58·36	32·01	37·85
Extremes for the 18-year period (low)	1·07	1·63	·95	·65	·67	1·09	·52	1·19	·92	·41	1·03	·69	30·50	22·94	31·19
(yr.)	1944	1941	1937	1946	1936	1952	1936	1948	1943	1944	1939	1943	1937	1941	1946
(high)	8·13	5·79	4·83	9·90	5·89	6·21	7·90	5·56	5·74	5·30	6·10	5·99	91·50	42·14	46·96
(yr.)	1937	1939	1948	1937	1943	1945	1942	1952	1944	1942	1950	1949	1947	1937	1945

TABLE 2.—FROST RECORDS

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

Year	Last frost in spring		First frost in fall		Number of frost-free days	Last killing frost in spring		First killing frost in fall		Number of days free from killing frost above 28°F.
	Date	Temp.	Date	Temp.		Date	Temp.	Date	Temp.	
1946	May 13	28·9	Oct. 13	32·0	153	Apr. 28	24·0	Nov. 15	22·8	201
1947	May 10	21·0	Sept. 26	28·4	138	May 10	21·0	Oct. 1	25·1	175
1948	May 1	30·0	Oct. 18	31·8	169	Apr. 18	27·5	Oct. 21	25·3	186
1949	June 8	30·4	Sept. 25	32·0	108	Apr. 25	21·8	Oct. 25	23·9	183
1950	May 8	25·8	Oct. 5	32·0	150	May 8	25·8	Oct. 26	23·9	171
1951	May 13	30·5	Sept. 29	30·0	140	Apr. 21	25·0	Oct. 20	27·0	182
1952	May 17	32·0	Oct. 4	29·0	140	Apr. 12	27·5	Oct. 9	28·0	179
19-year average	May 16	.....	Sept. 30	.....	138	May 4	.....	Oct. 18	.....	167
Shortest crop season, 1949	June 8	30·4	Sept. 25	32·0	108	May 8 1950	25·8	Oct. 26	23·9	171
Longest crop season, 1948	May 1	30·0	Oct. 18	31·8	169	Apr. 28 1946	24·0	Nov. 15	27·8	201

Earliest and latest frost dates (32°F. or lower) 1934–52:
Latest spring frost—June 8, 1949—30·4°F.
Earliest last spring frost—April 30, 1944—32·0°F.
Earliest fall frost—Sept. 12, 1943—31·5°F.
Latest first fall frost—Oct. 18, 1948—31·8°F.

Earliest and Latest killing frost dates (28°F. and lower) 1934–52:
Latest spring killing frost—May 23, 1934—25·0°F.
Earliest last killing frost in spring—April 20, 1937—28·0°F.
Earliest fall killing frost—Sept. 29, 1942—24·9°F.
Latest first killing frost in fall—Nov. 15, 1946—22·8°F.

TABLE 3.—TEMPERATURE, SUNSHINE AND EVAPORATION DATA, DELHI, ONTARIO

Month	Mean Monthly Temperature	Highest record		Lowest record		Sunshine hours 18-year average 1935–1952	Free water evaporation inches, 8-year average 1945–52
		Temperature	Year	Temperature	Year		
January	23·2	65·1	1950	−19·5	1940	63·3	.....
February	23·3	56·5	1937	−19·3	1943	91·3	.....
March	32·3	76·8	1946	−12·0	1950	119·3	.....
April	43·4	84·3	1942	10·5	1940	156·8	.....
May	55·6	87·5	1941	21·0	1947	213·2	3·61
June	65·7	95·0	1952	30·4	1949	243·0	4·50
July	70·3	105·0	1936	39·0	1939	271·2	5·77
August	68·6	97·8	1948	33·0	1940	245·8	5·14
September	60·7	93·0	1952	24·9	1942	174·4	3·36
October	50·3	86·0	1946	17·5	1936	146·9	2·16
November	37·8	71·5	1938	−2·0	1951	78·7	.....
December	25·7	64·6	1941	−18·0	1942	59·8	.....
Annual	46·4	105·0	1936 July	−19·5	1940 January	1,863·7	24·53

The heaviest annual rainfall during the period of the report occurred in 1951 with 35·4 inches and the lowest on record was 22·9 inches in 1941. In 1946 only 27·5 inches were received. The heaviest annual snowfall was in 1947 with 91·5 inches, and the lowest in 1946 with 36·8 inches. The average annual rainfall at Delhi, over the 18-year period, is 32·0 inches, and the average annual precipitation is 37·85 inches. In comparison with the various parts of Canada, the distribution of rainfall in the Delhi area is usually satisfactory. Tobacco often suffers from lack of moisture during July because of the high rate of evaporation and transpiration and the low moisture reserve in light sandy soil.

The latest spring frost (official 32°F. temperature or lower) occurred on June 8, 1948, at 30·4 degrees and the earliest fall frost on September 25, 1949, at 32·0 degrees. The shortest frost-free period, 108 days, was in 1949. The average frost-free period at Delhi for 19 years was 138 days. The mean annual temperature at Delhi for the period 1935-1952 was 46·4 degrees. The highest temperature occurred in 1936 at 105·0 degrees and the lowest in 1940 at −19·5 degrees. Records show that July is the month of greatest bright sunshine, averaging 271·2 hours. This month also has the highest mean temperature of 70·3 degrees and the greatest free water evaporation of 5·77 inches.

FLUE-CURED TOBACCO

Relation of Rainfall to Tobacco Culture

The amount and distribution of rainfall is important in producing both quality and yield of flue-cured tobacco. The uncertainties of weather constitute the principal hazard confronting the tobacco grower in his effort to produce tobacco of a given type and of high quality. Rainfall is the most important variable and is normally fairly well distributed; but there are seasons when irrigation would be beneficial. Overhead irrigation is becoming increasingly popular in the tobacco growing districts of Ontario, and in order to obtain information, rainfall data were studied over a period of 18 years to correlate rainfall and the relative returns from tobacco.

Several irrigation systems are now operating along Big Creek, Otter Creek, Catfish Creek and Young Creek in Norfolk and Elgin counties, Ganaraska River in Durham county and Nottawasaga River in Simcoe county. As yet, no definite information is available on tobacco irrigation, but, the Substation is conducting experiments in 1953 to determine rates, frequency of irrigation, and critical periods when irrigation is most necessary to produce high yield and quality.

Since 1935 the precipitation from May 1 to the end of harvest varied from 7·3 inches to 20·3 inches, averaging 14·3 inches. This average is probably sufficient provided the distribution is fairly regular, particularily after July 1. In general the best seasons were when the rainfall was fairly low in June. Low rainfall in the early part of the growing season ordinarily retards new top growth and tends to produce a substantial root system which promotes rapid growth later in the season. Excessive rainfall during the early growing season may be the cause of a serious set back, should a drought occur in July or August. Table 4 shows relative indexes of crops from 1935 to 1952, compared with the amount of rainfall at various periods during the growing season. The relative returns are based on 100 for 1938.

TABLE 4.—RELATION OF RELATIVE RETURNS FROM TOBACCO AND RAINFALL DISTRIBUTION FOR EIGHTEEN GROWING SEASONS 1935–52

Year	Relative return from tobacco	Inches rain from May 1 to end of harvest	Rainfall first two weeks after transplanting	Percentage of May-Aug. rainfall in July and Aug.
1951	121·4	14·8	·92	50·1
1938	100·0	13·4	·84	61·6
1950	98·4	13·6	·39	68·4
1937	95·7	14·9	1·00	52·9
1952	94·1	17·8	·04	68·5
1941	94·1	12·4	·70	32·8
1946	92·4	11·9	·92	43·6
1939	91·8	10·3	·89	64·5
1949	86·0	14·0	·00	61·2
1942	84·5	15·3	1·08	59·9
1935	75·5	12·0	1·02	42·7
1943	62·4	20·3	1·67	45·5
1947	57·3	18·5	1·57	40·5
1940	55·3	17·4	·06	31·4
1944	54·9	16·1	1·30	50·9
1948	50·2	10·7	1·31	24·2
1945	46·1	16·5	2·96	28·0
1936	25·9	7·3	1·28	38·9
Mean	77·0	14·3	·99	

Since 1946 five crops were fairly good. Each of them received less than one inch of rain during the first two weeks after transplanting, while the two poorest crops received 1·31 and 1·57 inches in the same period. The nine best crops since 1935 received one inch or less rainfall during the first two weeks after transplanting. The nine poorest crops received over one inch, with the exception of 1940 when 5·6 inches of rain fell in May and 5·58 in June (all in the latter half of the month), and only 1·28 inches in July. Although only ·06 inches fell during the first two weeks after transplanting there was ample moisture until July when a severe drought occurred.

The data tend to substantiate the past observations that flue-cured tobacco requires a fairly dry period two to three weeks after transplanting, followed by regular weekly rains of approximately one-half inch until the commencement of harvest. An average rainfall of 14 inches, well distributed throughout the

growing period, appears sufficient. Irrigation can be considered an insurance during dry periods in July and August as its use throughout the season is rarely necessary.

Notes on Soil Moisture Conditions 1946-52

There is, generally, adequate soil moisture available for the growth of tobacco in the district. A study of the distribution of the balance between rainfall and the moisture required by tobacco during the period 1946-52 indicates three distinct moisture periods throughout the growing season. On the average there is sufficient, at times an excess, of soil moisture during the early part of the season. A period of soil moisture deficiency follows from the last week in July until the third week in August. Thereafter there is generally a sufficient supply of soil moisture throughout the harvesting period.

In 1946, a drought persisted from early July to the end of harvest. Occasional rainfalls at criticial times maintained normal growth, and although the moisture-deficiency period appeared extensive, at no time was the deficiency particularly severe. The average yield was high and the quality fair.

The 1947 growing season was characterized by an extensive period of moisture deficiency during the greater part of the growing season. The tobacco made good initial growth but an insufficient supply of moisture following topping resulted in extensive wilting and a severe decline both in yield and quality of tobacco. The yield recorded in 1947 was the lowest for the 7-year period covered by this Report.

The 1948 season was characterized by an extensive moisture-deficiency period throughout the greater part of the growing season. Yields were relatively low since the tobacco did not develop properly. Quality was fairly good although the tobacco was short and fairly thick. Rainfall during the latter part of the harvesting period had little effect on yield or quality.

The 1949 crop year was similar to that of 1952 in many respects. Moisture-deficiency periods in late June retarded growth in both seasons, but in 1949 extensive rainfall and sufficient soil moisture during early July promoted good growth and a high yield of fairly good quality tobacco.

Soil-moisture conditions were generally favorable in 1950. A dry period that approached deficiency proportions was evident after planting. This promoted good root development and resulted in good plant growth when moisture became available. Droughty conditions following topping checked growth, but a good crop of average weight and excellent quality was harvested.

The 1951 soil moisture conditions could be considered normal with ample moisture throughout the growing season until harvest. A slight deficiency period began shortly after topping and continued until the end of harvest. The resultant crop was of excellent quality and good weight, being slightly above the 6-year average.

The 1952 soil-moisture conditions were abnormal because of a deficiency period occurring in mid-June which restricted the normal development of the plants. Many tobacco crops were short at topping but developed into heavy crops of fair quality tobacco with the high available moisture present throughout the harvest period. The tobacco yields recorded in 1952 were the highest ever produced in Ontario. This was undoubtedly the result of the low rainfall in June which permitted the root system to become well established.

Tobacco Seedbeds

A well managed flue-cured tobacco greenhouse should provide enough uniform, strong healthy plants to transplant one acre from every 100 square feet of seedbed. Several methods of growing seedlings are practised in the district, but to prevent unnecessary difficulties certain procedures are recommended by the Substation.

Special attention is required when selecting the greenhouse site, preparing the soil, selecting suitable muck, sterilizing the soil and fertilizing, seeding, watering, and ventilating the seedbeds. Greenhouses should be located on sandy, well drained soil in a sheltered but unshaded area. Each year the original soil should be spaded at least six inches deep; merely forking the soil is insufficient to provide good drainage. The old muck should be removed, and new, well decayed muck, free of foreign material such as clay or sand, should be applied every year. A 1½-inch layer is enough to hold moisture and provide an open medium for the roots. Heavier applications cause poor drainage, while lighter applications fail to supply sufficient water-holding capacity during warm, bright days.

Steam sterilization is necessary to eliminate diseases and weed seeds. Proper sterilization helps to destroy such diseases as blue-mold, black root rot and damping-off, where these are present. Steam generators and boilers are satisfactory provided they are capable of producing a sufficient volume of steam. With ordinary steam boilers, 100 or more pounds of steam should be maintained at the boiler with sufficient volume entering the pan to produce, in ten minutes, a temperature of 180° F. at a depth of six inches. The soil should be moist as steam fails to penetrate soil that is too wet or too dry. Satisfactory results usually can be produced by steaming each pan one-half hour. Seedbed difficulties often occur when less time is taken.

In 1950 a steam generator was tested for sterilizing tobacco seedbeds. Table 5 compares the results of the 1950 test with similar results obtained from a steam traction boiler in 1940. At a 6-inch depth the steam generator produced a temperature of 180°F. in 8 minutes, which is satisfactory for steaming tobacco seedbeds. All results were essentially the same as those obtained when using the steam boiler in 1940.

TABLE 5.—RESULTS OF COMPARISON BETWEEN STEAM GENERATOR AND STEAM BOILER FOR STERILIZING TOBACCO SEEDBEDS

Description of data	Steam generator	Steam boiler
Depth of thermometer	6 inches	6 inches
Time of continuous flow of steam	30 minutes	30 minutes
Size of pan	54 sq. ft.	54 sq. ft.
Steam pressure	105 pounds	110 pounds
Length of period 180°F. maintained	80 minutes	99 minutes
Time required to reach 180°F.	8 minutes	9 minutes

Sterilization of the walls and walks may be accomplished by applying a solution of formaldehyde mixed in the water tank, using approximately 2 gallons of formaldehyde to 50 gallons of water for a greenhouse 3,600 feet square. Applications should be made in a closed greenhouse early in the morning to prevent eye and throat irritations, and the greenhouse left closed for the rest of the day. The greenhouse should be ventilated for at least three days prior to seeding to prevent germination injury.

Proper fertilization is extremely important for producing strong, healthy seedlings. One hundred pounds of 2-12-10 tobacco fertilizer per 900 square feet of seedbed is ample fertilizer until after the first pulling. Over-fertilization,

particularly with high-nitrogen fertilizers or manure, often causes "yellow-patch", a seedbed disorder commonly observed throughout the district. The plants turn yellow because of a high concentration of nitrite nitrogen in the soil, which causes the roots to rot. Injured plants become stunted and revive only when new roots develop. "Yellow-patch" areas may be aided by loosening the soil and delaying watering for two or three days. After the first pulling, a light application of 2-12-10 fertilizer, 25 pounds per 1,000 square feet of seedbed, dampened before applying, is sufficient to hasten the remaining plants. A heavy watering after broadcasting is essential to prevent the fertilizer from burning the foliage.

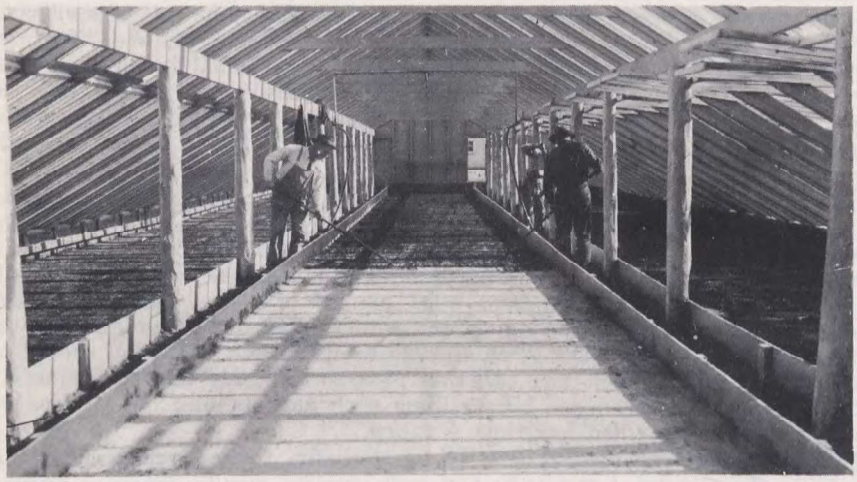

Figure 1.—Applying 2-12-10 fertilizer to a flue-cured tobacco seedbed.

Registered tobacco seed is recommended to assure good germination and purity of variety. Registered seed producers are required to obtain their foundation stock seed from the Dominion Experimental Substation for reproduction, and the production is controlled by the Plant Products Division, Canada Department of Agriculture.

The rate of seeding tobacco seedbeds governs the number, size, and strength of plants available for transplanting. A test was conducted from 1941-1946 on rates of seeding, the results being presented in Table 6.

TABLE 6.—NUMBER OF TRANSPLANTABLE SEEDLINGS FROM DIFFERENT RATES OF SEEDING, 1941–46

(6-year average)

Rate of seeding	Average number of seedlings per 100 sq. ft.	
	Before June 5	Total during season
1 oz. per 1,400 sq. ft.	4,241	7,992
1 oz. per 1,600 sq. ft.	4,337	8,653
1 oz. per 1,800 sq. ft.	3,839	7,814

The highest number of transplantable plants was produced from a seeding of one ounce to 1,600 square feet. However, sturdier plants were produced from the lighter rate which is recommended if sufficient seedbed space is

available. Heavy rates tend to produce spindly plants with small root systems that are slow in growing when transplanted. In another experiment (Table 7) the lighter rates of one ounce to 1,800, 2,400 and 3,000 square feet, respectively, were tested. No outstanding differences were obtained either in yield or quality from the tobacco produced. However, the lighter applications tended to promote earlier maturity, undoubtedly because the stronger plants developed more rapidly. The number of replants was less with the light rates of seeding.

TABLE 7.—EFFECT OF RATES OF SEEDING ON SEEDBED POPULATION, PLANTS PULLED, AND NUMBER OF REPLANTS REQUIRED, 1951–52

(2-year average)

Rate of seeding	Plant population per square foot	Plants pulled per square foot	Percentage replants
1 oz. 1,800 sq. ft.	120	52	15
1 oz. 2,400 sq. ft.	115	50	3
1 oz. 3,000 sq. ft.	87	47	3

Fifteen per cent of the plants pulled from the rate 1 ounce to 1,800 square feet required replanting, while only 3 per cent were replanted in the two lighter rates. The total population dropped considerably with the light rate of seeding, but the actual number pulled for transplanting remained fairly constant. If seedbed space is available the lighter rates are advisable since they result in strong healthy plants.

Figure 2.—A uniform stand of tobacco seedlings.

Seedbeds in Ontario are usually sown the first week of April, and the seedlings transplanted the latter part of May and early June. Seed may be sown wet or dry. Dry seed is usually sown mixed with either wood ashes or fertilizer, while soaked or sprouted seed is sown with a sprinkling can. Dry seed is preferable to sprouted seed as often sprouted seed is damaged by overheating during germination. Seedbeds may be lightly pressed but should not be rolled

after seeding. A roller or any other heavy implement causes compaction, jeopardizing the aeration and drainage of the soil. Severe compaction may cause "yellow patch", if there is excessive fertilizer and moisture present. A loose soil permits good drainage and aeration, reducing seedbed difficulties. Success in growing satisfactory plants depends largely on when and how much water is applied. Seedbeds should be kept moist, but not soaked, until the seedlings appear. Drying the surface of the muck one or two days following germination permits the roots to enter the soil and prevents the plants from "heaving out" or "turning over". Ample ventilation prevents over-heating during this period. After the plants are well established one good watering in the morning and none in the afternoon is sufficient until transplanting season. Watering late in the day encourages such seedbed diseases as damping-off and blue-mold.

Ventilation is required for regulating temperature and moisture. Optimum growth takes place at approximately 88°F. Ventilation during warm nights reduces diseases by keeping the plants dry. Keeping a greenhouse closed promotes high humidity and provides satisfactory conditions for the growth of blue-mold.

Tobacco seedlings will withstand extreme temperatures and drought after being transplanted provided they are properly "hardened-off" in the seedbed. Hardening of plants is accomplished by ventilating and withholding water for three or four days before transplanting.

Flue-cured Tobacco Varieties

A large number of flue-cured tobacco varieties have been tested in recent years for the purpose of improving the quality and yield of tobacco in Ontario. Varieties developed at Harrow and Delhi, standard varieties in the district, and prominent varieties from the United States have been included in the tests. Black root rot, caused by the fungus *Thielaviopsis basicola*, was one of the most troublesome diseases encountered in Ontario until the resistant variety Delcrest was developed by the Harrow and Delhi Stations, and released to growers in 1948. Since then, other resistant varieties have been introduced from the United States. The introduction of new varieties resistant to black root rot has greatly improved the yield, quality, and uniformity of flue-cured tobacco grown in Ontario.

At present, practically all the tobacco varieties grown in Ontario are resistant to black root rot; susceptible varieties such as White Mammoth, Yellow Mammoth, Gold Dollar, Bonanza, and Duquesne are no longer popular. Since 1948, Delcrest has been the most outstanding variety, but other resistant varieties such as Hicks, Jamaica Wrapper, and Virginia Gold have achieved popularity in that order.

TABLE 8.—AVERAGE YIELD, GRADE INDEX, CROP INDEX, AND MATURITY INDEX OF FLUE-CURED TOBACCO VARIETIES, 1947–52

(6-year average)

Variety	Grade index (¢ per lb.)*	Yield per acre (lb.)	Returns per acre ($)	Maturity index**
Delcrest	44·5	1,639	730	60·0
Jamaica Wrapper	41·3	1,734	716	60·0
Oxford 402	41·3	1,641	678	62·8
White Mammoth	40·5	1,537	622	58·1
Yellow Mammoth	41·4	1,500	621	60·9
Gold Dollar	40·9	1,486	608	58·1
Duquesne	42·2	1,434	606	62·8
Bonanza	41·6	1,439	598	60·0

TABLE 9.—AVERAGE YIELD, GRADE INDEX AND CROP INDEX OF FLUE-CURED TOBACCO VARIETIES, 1951–52

(2-year average)

Variety	Grade index (¢ per lb.)	Yield per acre (lb.)	Returns per acre ($)
Test 1—			
Jamaica Wrapper	41·8	2,057	860
Delcrest	43·8	1,952	855
Hicks	42·9	1,989	853
Oxford 402	41·9	1,982	830
White Mammoth	40·3	1,779	717
Test 2—			
Virginia Gold	42·8	2,170	929
Delcrest	43·8	1,968	862
Yellow Special "A"	45·3	1,859	842
Vamorr 50	39·3	2,054	809
White Mammoth	41·7	1,772	739

* All grade indices are based on average district prices during the term of each table.
** High maturity figures represent earliness.

TABLE 10.—AVERAGE YIELD, GRADE INDEX AND CROP INDEX OF THREE FLUE-CURED TOBACCO VARIETIES, 1950–1952

(3-year average)

Variety	Grade index (¢ per lb.)	Yield per acre (lb.)	Returns per acre ($)
Virginia Gold	43·7	2,073	905
Delcrest	44·1	1,840	824
White Mammoth	42·6	1,701	731

TABLE 11.—NUMBER AND SIZE OF LEAVES OF FLUE-CURED TOBACCO VARIETIES, 1951–1952

(2-year average)

Variety	Average length (in.)	Average width (in.)	Average no. leaves
Test 1			
Jamaica Wrapper	21·3	9·7	19·3
Delcrest	21·2	10·5	15·5
Hicks	21·0	10·2	18·2
Oxford 402	19·7	11·1	17·1
White Mammoth	20·3	9·5	17·1
Test 2			
Virginia Gold	21·7	12·0	17·0
Delcrest	21·2	10·5	15·5
Yellow Special "A"	21·0	11·5	17·0
Vamorr 50	20·1	11·6	16·6
White Mammoth	20·3	9·5	17·1

Several years of testing are necessary to definitely establish the merits of a strain or variety of tobacco. Varieties having undesirable characteristics can be quickly eliminated, but thorough testing is necessary before a suitable variety can be released to the public. Since 1946, 27 different varieties have been tested for resistance to root rot, quality, yield, chemical constituents, and physical characteristics, to determine their suitability to Ontario conditions, and for Canadian and export markets. In 1952 the four most popular varieties grown were Delcrest, Hicks, Jamaica Wrapper, and Virginia Gold.

Figure 3.—A typical tobacco plant of the Delcrest variety.

Description of Varieties

Delcrest, developed and tested by the Harrow Station and the Delhi Substation and released in 1948, has been the most popular variety in the district since 1949. This variety is resistant to black root rot but susceptible to brown root rot. Under average growing conditions the leaves are long and of medium width, maintaining a good size throughout the plant. Delcrest should be topped fairly high, particularly in dry seasons, since the leaves are spaced well apart. Good quality sand leaves may be obtained by priming them slightly green, while the remaining leaves should be well matured before being harvested. All primings are easily cured, as the variety is difficult to sponge, this permits the yellowing stage to continue longer than for most other varieties. Sand leaves should be yellowed, then dried as quickly as possible to prevent dead tissue.

Under proper conditions Delcrest produces a bright, heavy-bodied leaf, high in sugar content. Results over a period of six years show that this variety produced the highest quality leaf and 100 pounds more yield than White Mammoth, the most prominent variety prior to 1949. Delcrest has consistently produced high yields since first tested in 1946. For best results, it should not be over fertilized, particularily with nitrogen, since excess nitrogen delays maturity. Delcrest may be grown on most soils suitable for tobacco provided it is properly fertilized.

Hicks, a farmer's selection from North Carolina and recently introduced to Ontario, has become popular throughout the district. This variety is resistant to black root rot but fairly susceptible to brown root rot. The leaves are long and medium in width, tapering to a sharp point and spaced fairly closely together. Since Hicks produces more leaves than Delcrest it should be topped lower to produce tips of good size. This variety is severely affected by unfavorable weather conditions; a wet June followed by a dry July may cause it to form bud prematurely. Hicks tends to produce a higher percentage of cutter and less body leaf tobacco than Delcrest, making it more susceptible to drought conditions resulting in considerable burning of the lower leaves. Hicks yields approximately the same as Delcrest, but often produces a thin-shouldered leaf. Hicks usually cures a bright flashy color, but if yellowed too long tends to turn reddish orange. Over a period of two years Hicks was lower in quality than Delcrest. Most flue-cured tobacco soils are suitable for Hicks provided the fertilization is closely adhered to.

Jamaica Wrapper has been grown in Ontario several years. This variety is also resistant to black root rot but fairly susceptible to brown root rot. The leaves are long, narrow, somewhat crinkly, and spaced closely together on the stalk. Jamaica Wrapper produced the highest yield in the 6-year test but was only average in quality, bringing 3·2 cents less per pound than Delcrest. This variety sponges more easily than Delcrest or Hicks and fails to produce a bright leaf under most conditions. The stem in this variety is often large in comparison with the lamina. Jamaica Wrapper produces good quality on fairly light soils, while on heavy soils the quality is often inferior.

Virginia Gold, a recent introduction from Virginia, is a selection from a cross between Yellow Special and Cash. The variety is resistant to both black and brown root rot. The leaves are fairly long and broad, rather thin at the bottom of the plant, but thick at the top. The plant grows with a yellow cast, appearing ripe prematurely. Growers are cautioned to harvest Virginia Gold only when the leaves are well ripened. In tests at Delhi this variety produced the highest yield per acre recorded over a period of three years, an increase of 233 and 372 pounds per acre over Delcrest and White Mammoth, respectively (Table 10). This variety is difficult to cure without sponging the leaf. The bottom leaves are extremely thin, while the upper leaves are thick and somewhat leathery. At present this variety is recommended only on soils known to be infested with brown root rot.

Oxford 402, a variety introduced from North Carolina, is partly resistant to black root rot and is a fair yielder in Ontario. Over a period of six years this variety produced approximately the same yield as Delcrest but was lower in quality. The variety has long broad leaves, medium spaced on the plant, and is somewhat similar to Jamaica Wrapper in structure.

Yellow Special "A", a variety recently introduced from Virginia has produced favorable quality over a period of two years. The variety has broad leaves, medium spaced on the plant, and like Virginia Gold, grows with a yellow cast, throughout the growing season. This variety is not popular in Ontario but may have possibilities because of its outstanding quality. The yield so far has been only average.

Vamorr 50, a variety recently developed in Virginia, is resistant to mosaic disease. Although in two years this variety produced outstanding yields, the quality was somewhat inferior when compared with other varieties. The leaves were found to be rather smooth, rounded and of medium length and medium spacing on the stalk. This variety produced a fairly high percentage of N.D. (scrap) tobacco and is recommended only where mosaic might be very severe.

White Mammoth was the most popular variety in Ontario prior to the introduction in 1949 of varieties resistant to black root rot. This variety is very susceptible to black root rot and since the newer varieties produce higher yields it is no longer popular in the district. White Mammoth grows medium tall with medium spaced leaves of good length, tapering to the tip. The leaf has a fair body and good texture throughout the plant, but sponges readily during curing. White Mammoth is fairly resistant to brown root rot and is preferred to Yellow Mammoth because of this characteristic.

Yellow Mammoth, a variety similar to White Mammoth, is susceptible to both black and brown root rot diseases and therefore is no longer popular in the district. At one time considerable acreage of Yellow Mammoth was grown in Ontario.

Bonanza, a popular early-maturing variety, has been dropped because of its susceptibility to black root rot. Over a period of six years this variety produced a relatively low yield but fair quality tobacco. Bonanza was popular on the more productive soils, specially those of the fine sandy loam type. This variety has very fine texture and good body and is lemon to lemon-orange in color.

Gold Dollar, a well known variety in the late forties, lost its popularity because of susceptibility to black root rot. The yield of Gold Dollar was slightly lower than that of White Mammoth and grew best on medium to light soils. The variety is now considered obsolete.

Duquesne, the earliest maturing variety known in Ontario, was once considered outstanding on the heavy flue-cured soils, but has become obsolete in recent years because of low yields and susceptibility to black root rot. Duquesne has been replaced by resistant varieties on the heavy soils where black root rot is prevalent.

Breeding and Selection of New Varieties

During the period of this report the tobacco breeding and selection program has been conducted jointly at the Harrow and Delhi Stations. Variety and strain tests on flue-cured tobacco are conducted principally at Delhi and Copenhagen. The primary object of the plant breeding program has been to develop a high yielding, good quality flue-cured tobacco strain, resistant to both black and brown root rot. Good progress has been made toward producing desirable varieties and strains since 1946. Delcrest has been a very successful variety since its release in 1948, and since that time over half of the tobacco produced in Ontario has been of the Delcrest variety. Other countries are also finding Delcrest to be an outstanding variety.

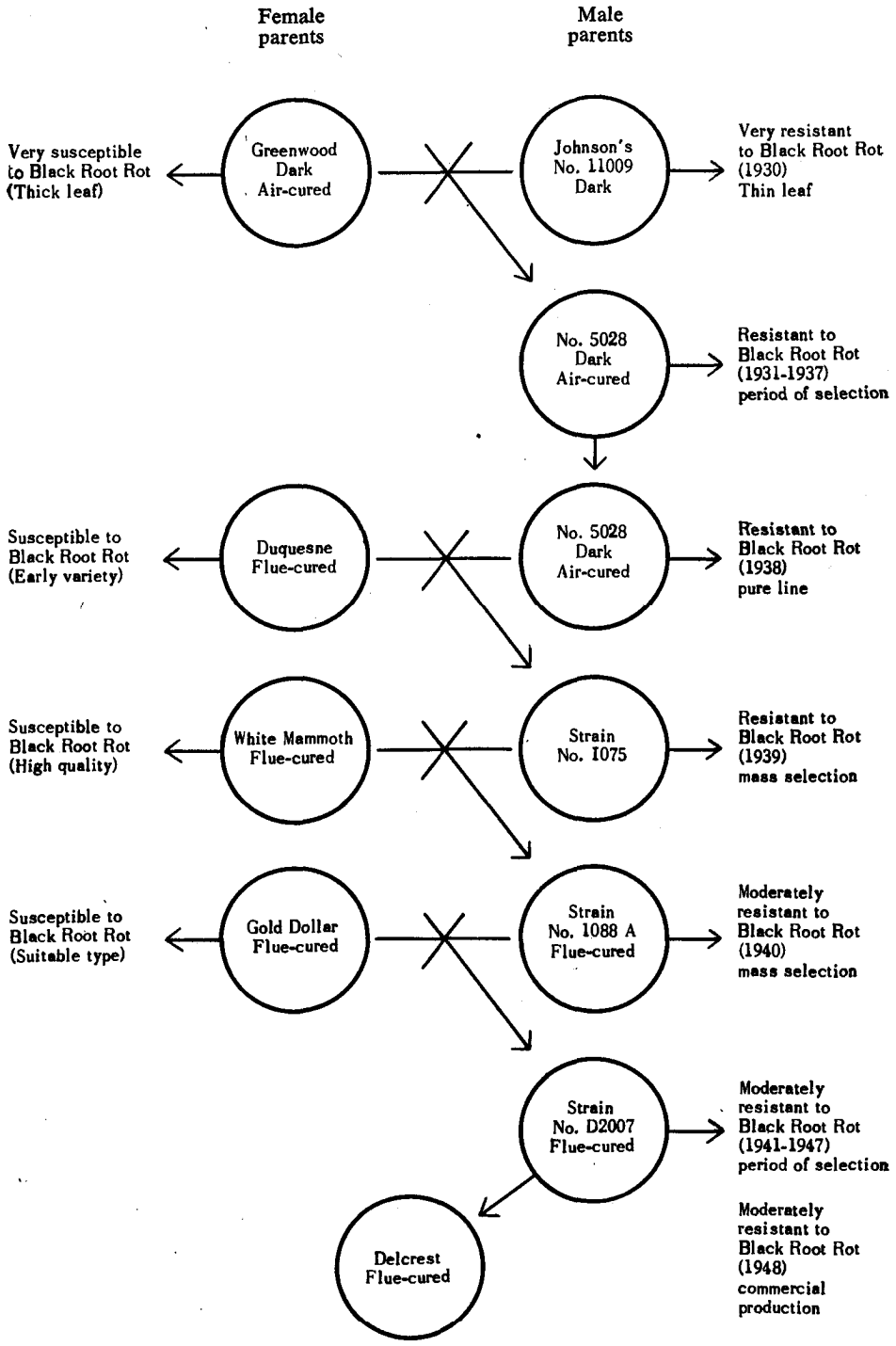

Chart 1.—Illustration of Delcrest pedigree.

Strain R21, developed from a cross involving Jamaica Wrapper and Delray, has shown considerable resistance to black root rot and some resistance to brown root rot. Over a short term this strain has produced similar quality and slightly higher yields than Delcrest. R21 may soon be named and released to growers if present tests are satisfactory. The history of R21 is shown in Chart 2.

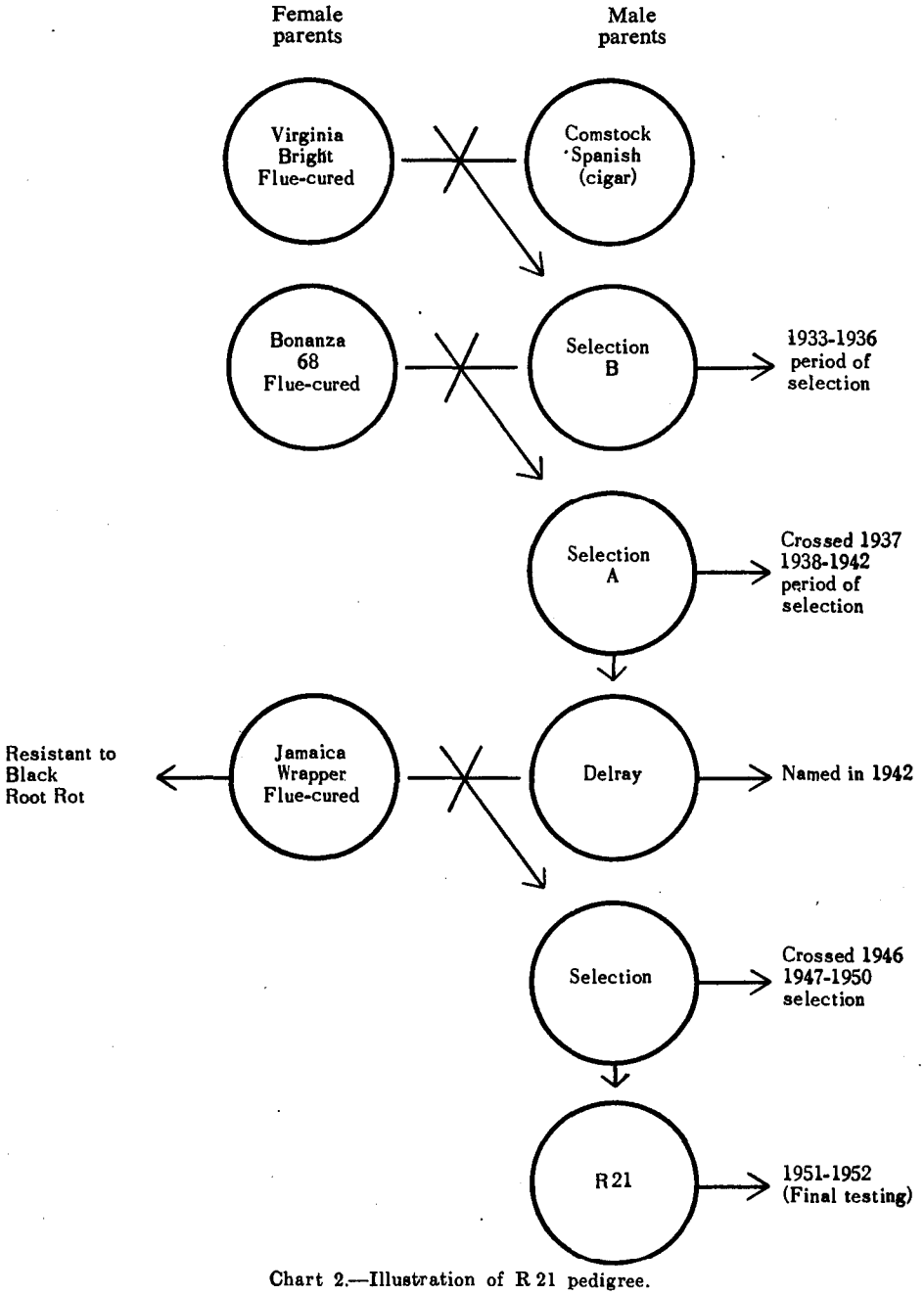

Chart 2.—Illustration of R 21 pedigree.

Strain R11, a strain developed from H2009 and Delcrest, also has considerable resistance to black root rot and some resistance to brown root rot. This strain resembles certain American-type varieties having lighter color and body than most Canadian varieties. In recent tests R11 has produced high yields and good quality.

Other strains with similar parentage to R21 and R11 have shown considerable promise and are being compared with standard varieties for yield, quality, and resistance to black and brown root rot. Strains developed from crosses involving Delcrest, Virginia Gold, Jamaica Wrapper, Hicks, Vamorr 50, Duquesne, Bells 3 and others, are under continued test; a number are showing desirable characteristics. At present selections for resistance to black and brown root rot and mosaic are being made from crosses of Virginia Gold and Vamorr 50.

Selections by tobacco farmers are also tested when they show promising characteristics. Several strains of Jamaica Wrapper have produced exceptionally high yields but only average quality. Seed of Hicks from various sources was tested in 1952 to determine whether there were any outstanding differences. There was no significant difference among the sources grown indicating that they probably originated from the same strain.

Varieties introduced from the United States undergo preliminary tests for suitability of type, yield, quality, and resistance, and if desirable, undergo further testing in the standard variety test. Most varieties from the United States possess a thin-bodied leaf not suited for Ontario conditions but often are excellent for further breeding work. Virginia Gold, Yellow Special "A", Hicks and Vamorr 50 have shown desirable characteristics and have been used in the plant breeding program. Vesta and Dixie Bright strains are not suitable in Ontario since they are thin and susceptible to wind damage. Seed stocks of these varieties are being held, however, because they are moderately resistant to black shank, an unknown disease in Ontario. Varieties such as the Bell's strains, Oxford 1-181, Bottom Special, and Yellow Special are of doubtful importance but warrant continued testing.

Hybrid tobacco has been tested in recent years with very little success. In 1952 a first generation hybrid between Delcrest and Virginia Gold showed no significant difference in yield, quality, or returns per acre compared with the parent stock. Apparently these varieties are too closely related to show significant hybrid vigor. Selections from this cross appear promising for future varietal work, particularly since both are resistant to black root rot and Virginia Gold is resistant to brown root rot. Both varieties are outstanding in yield, and Delcrest also possesses high quality.

Tobacco Rotations

Winter rye and tobacco is the rotation most practised throughout the tobacco growing districts of Ontario. Rye is seeded in the fall after the tobacco harvest, combined the following summer, then the straw is disked under and the land reseeded to produce a green manure crop that is plowed under prior to a new tobacco crop. Rye protects the soil from wind and water erosion, improves the soil condition, and reduces diseases.

Since flue-cured tobacco soils range from light sands to sandy loams, the organic matter and necessary nutrients need to be replenished after the removal of each tobacco crop. Rye is an excellent crop for supplying organic matter and nutrients for tobacco. Since rye is a non-legume crop that tends to reduce soil nitrogen, commercial nitrogen fertilizers are now recommended to supply the soil micro-organisms with food for proper decomposition of the straw. Additional potash is sometimes added to improve the soil productivity.

The 2-year, rye-tobacco rotation was too short to eliminate black root rot disease before resistant varieties were introduced in 1948. Now this rotation has become a sound practice throughout the district, maintaining, and in some instances improving, the productiveness of the soil.

To protect the tobacco farmer from fluctuations in markets, several 3- and 4-year rotations were conducted from 1941 to 1948, to evaluate the possibility of growing other crops. The crops consisted of rye, field corn, sweet corn, oats, red clover, and early potatoes. All 3- and 4-year rotations were discontinued in 1948 to permit further work on other more important investigations.

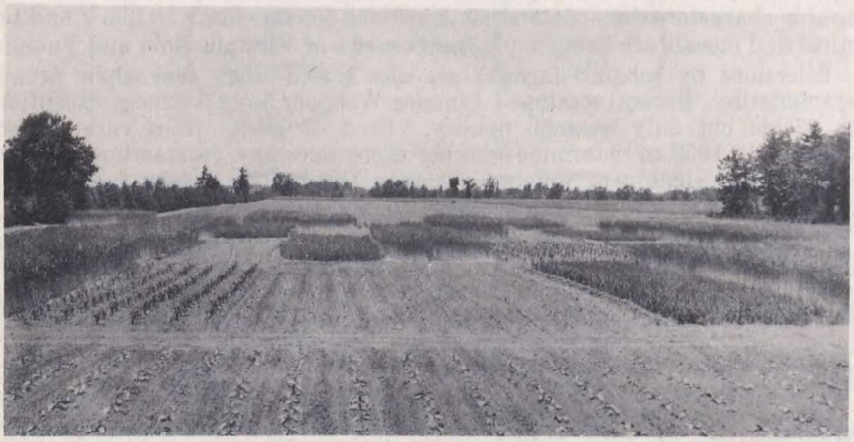

Figure 4.—A series of crop rotations at Delhi.

Four-year Rotations

The 4-year rotations completed two cycles during 1941-1948. Several changes in crops and fertilization were necessary during this period to meet the tobacco requirements.

The original rotations were as follows:

A. Fall wheat, sweet clover, rye, tobacco.
B. Corn, oats, rye, tobacco.
C. Corn, potatoes, rye, tobacco.
D. Rye, tobacco (check).

Five tons of manure were applied on the rye at the time of disking and ten tons on all crops following tobacco in the 4-year rotations. The potatoes received 500 pounds of 4-8-10 fertilizer per acre, and the tobacco 1,000 pounds of 2-10-8. By 1944 certain alterations were made to compensate for deficiencies and overcome unforeseen difficulties with certain crops. The fall wheat in rotation A was replaced by potatoes because of low wheat yields. The 10-ton application of manure was discontinued in rotation A because the potatoes were fertilized with commercial fertilizer. Red clover replaced the sweet clover because of poor catches of sweet clover. In rotation B the 5-ton application of manure was replaced by 200 pounds of calcium cyanamide and 100 pounds of muriate of potash per acre. In 1944 the fertilizer on the potatoes was increased from 500 to 1,000 pounds of 4-8-10 per acre. In all rotations the tobacco fertilizer was changed from 1,000 pounds of 2-10-8 to 800 pounds of 2-12-10 per acre.

TABLE 12.—GRADE INDEX, YIELDS AND RETURNS PER ACRE FROM THREE 4-YEAR ROTATIONS COMPARED WITH A 2-YEAR, RYE-TOBACCO ROTATION, 1945–1948 (TOBACCO)

(4-year average)

Rotation	Grade index (¢ per lb.)	Yield per acre (lb.)	Returns per acre ($)
A. Potatoes, red clover, rye, tobacco	36·6	1,516	555
B. Corn, oats, rye, tobacco	37·1	1,522	565
C. Corn, potatoes, rye, tobacco	35·9	1,509	542
D. Rye, tobacco	38·7	1,287	498

TABLE 13.—MEAN ANNUAL GROSS RETURNS IN DOLLARS PER FOUR ACRES FROM CROPS HARVESTED IN THE ROTATIONS, BASED ON 1948 PRICES

Rotations	Potatoes	Corn	Oat hay	Tobacco	Total
A. Potatoes, red clover, rye, tobacco	285	.....	.....	684	969
B. Corn, oats, rye, tobacco	.....	107	19	694	820
C. Corn, potatoes, rye, tobacco	295	111	.....	668	1,074
D. Rye, tobacco	.....	.....	.....	610 610	1,220

Four-year rotations are normally too long for flue-cured tobacco growing in Ontario, but the information obtained should be useful if future acreages are drastically reduced. The 4-year rotations produced outstanding yields compared with the 2-year rotation, however the short rotation was badly affected with black root rot. Normally rye is recommended preceding a tobacco crop as a soil conditioner and for reducing diseases. Early potatoes grow satisfactorily on light sandy soils provided they are properly fertilized. Table 13 shows that potatoes produced an average gross of $290 per acre based on 1948 prices. In the 4-year rotations, the rotation corn, potatoes, rye and tobacco, produced the highest total return from one acre of each crop. The 2-year, rye-tobacco rotation produced the highest returns, mainly because there were two crops of tobacco in four years.

TABLE 14.—ORGANIC-MATTER CONTENT AND pH OF THE SOIL BEFORE AND AFTER CONDUCTING 4- AND 2-YEAR ROTATIONS

Rotations	Percentage organic matter			pH		
	1941	1946	1948	1941	1946	1948
A. Potatoes, red clover, rye, tobacco	1·26	1·10	1·16	5·70	5·48	5·32
B. Corn, oats, rye, tobacco	1·27	1·31	1·20	5·52	5·45	5·10
C. Corn, potatoes, rye, tobacco	1·22	1·29	1·21	5·59	5·49	5·42
D. Rye, tobacco	1·11	1·18	1·05	5·50	5·68	5·79

The 4-year rotations, conducted on Fox sand tobacco soil, did not improve the organic-matter content (Table 14). There is an indication that the soil became more acid under the 4-year rotations and less acid with the rye-tobacco rotation. The increase in pH may have resulted from heavy applications of fertilizer containing dolomitic limestone as a filler in the 2-year rotation.

Three-year Rotations

Four 3-year rotations and one 2-year rotation were started in the spring of 1941 for the purpose of studying the effects of various rotations, cover crops and rest crops on maintaining or improving the quality and yield of flue-cured tobacco. The rotations were as follows:

A. Corn, oats, tobacco.
B. Sweet corn, rye, tobacco.
C. Rye, potatoes, tobacco.
D. Rye, rye, tobacco.
E. Rye, tobacco.

In rotation A the corn received ten tons of manure per acre in the spring and 500 pounds of 4-8-10 fertilizer at seeding. The stalks were left until the following spring, then plowed under to supply organic matter. Two hundred pounds of calcium cyanamide was applied to help decay the stalks. The oats were disked under at maturity along with 200 pounds of calcium cyanamide. The oat plots were sown to rye to supply a winter cover and a green manure crop in the spring. In 1945 the tobacco fertilizer was changed from 1,000 pounds of 2-10-8 to 800 pounds of 2-12-10 per acre. The sweet corn received 10 tons of manure and 500 pounds of 4-8-10 per acre. The stalks were cut and disked under in midsummer and rye seeded as in rotation A. Two hundred pounds of calcium cyanamide were applied on the rye straw at disking time. In rotation "C" 10 tons of manure in addition to 200 pounds of calcium cyanamide were applied on the rye straw at the time of disking. Potatoes received 1,000 pounds per acre of a 4-8-10 fertilizer. The rye-rye-tobacco rotation received 100 pounds of calcium cyanamide the first year and 500 pounds of a 10-10-10 analysis the second year when the straw was disked under in August. The regular 2-year, rye-tobacco rotation received 5 tons of barnyard manure when the rye straw was disked under in August.

TABLE 15.—GRADE INDEX, YIELD AND RETURNS PER ACRE FROM FOUR 3-YEAR ROTATIONS COMPARED WITH A 2-YEAR RYE-TOBACCO ROTATION, 1943–1948

(6-year average)

Rotation	Grade index (¢ per lb.)	Yield per acre (lb.)	Returns per acre ($)
A. Corn, oats, tobacco	39·5	1,471	581
B. Sweet corn, rye, tobacco	36·5	1,569	573
C. Rye, potatoes, tobacco	39·4	1,446	570
D. Rye, rye, tobacco	38·6	1,535	593
E. Rye, tobacco	37·9	1,495	567

TABLE 16.—MEAN ANNUAL GROSS RETURNS IN DOLLARS FROM CROPS HARVESTED IN THE ROTATIONS PER THREE ACRES OF OCCUPIED LAND, USING 1948 PRICES, 1943–1948

(6-year average)

Rotations	Tobacco	Shelled corn	Sweet corn	Potatoes	Total
A. Corn, oats, tobacco	709	107	.....	.....	816
B. Sweet corn, rye, tobacco	682	.....	276	.....	958
C. Rye, potatoes, tobacco	694	.....	.....	303	997
D. Rye, rye, tobacco	719	.....	.....	.....	719
E. Rye, tobacco	1,002	.....	.....	.....	1,002

There are advantages and disadvantages with each of the 3-year rotations. The corn, oats and tobacco rotation is conducive to the brown root rot disease. Brown root rot is often prevalent after corn and oats. The sweet corn, rye, and tobacco rotation has two outstanding cash crops, and is suitable in early districts where there is a market for sweet corn. Rye, potatoes, and tobacco is a good rotation on relatively heavy tobacco soils, but on light soils the potatoes may reduce the soil productivity and tobacco returns. A slight reduction in the tobacco yield has been observed in this rotation. The rye, rye, and tobacco rotation may be practised generally throughout the tobacco growing districts of Ontario. It is highly probable that all the rye straw, produced in this rotation, can be properly decomposed by a carefully managed fertilization program to improve the soil productivity for tobacco. A voluntary vetch crop may gradually develop in such a rotation but can easily be controlled by spraying with a 2,4-D amine spray before the rye reaches the shot blade stage.

A non-legume crop prior to tobacco is required to produce high quality tobacco. Legumes, such as alfalfa, clover, soybeans or vetch, store nitrogen in a slowly available form that causes delayed maturity and low quality leaf. Tobacco after corn, soybeans, oats, or timothy frequently suffers from brown root rot. Mosaic is often prevalent in tobacco following tomatoes or tobacco.

Flue-cured Tobacco Soils

Flue-cured tobacco is grown chiefly on such sandy and sandy loam soils as Plainfield, Fox, Burford, Berrien, Brighton, and Brady. These soils are relatively low in natural fertility and therefore large quantities of well balanced commercial fertilizers are necessary for tobacco production. As 1,000 to 1,200 pounds per acre of a 2-10-8 or 2-12-10 is applied to the crop, the fertility status of these soils has changed considerably since the introduction of tobacco.

Excessively drained soils developed on rolling topography such as the Plainfield are very low in fertility and subject to severe erosion. Maintenance of organic matter is of utmost importance in these soils if satisfactory yields of tobacco are to be produced. Additional sources of organic matter besides the rye crop must be applied to prevent excessive drainage and leaching of plant nutrients.

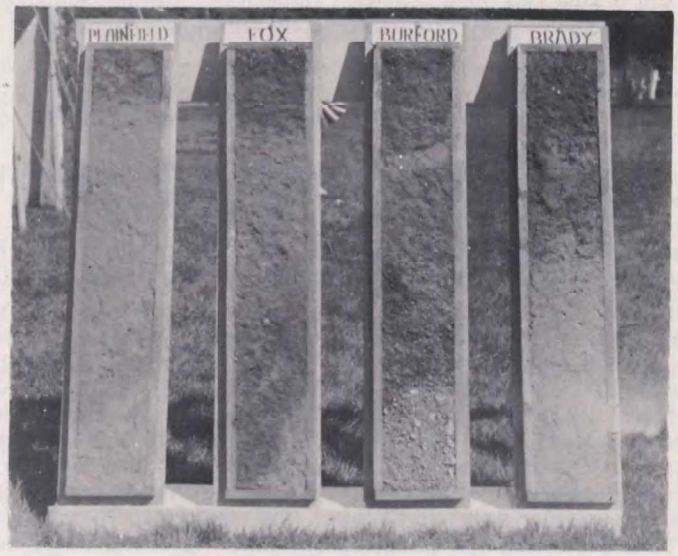

Figure 5.—Four types of flue-cured tobacco soils.

Most of the flue-cured tobacco in Ontario is grown on well-drained soils such as Fox sand. All experiments are conducted on Fox sand at the Delhi Substation. This soil has satisfactory physical characteristics capable of holding a suitable level of plant nutrients for producing high yields and good quality tobacco. It consists of a surface soil of 5 to 7 inches of coarse greyish brown sand, a second layer of loose brownish yellow sand 16 to 24 inches thick, and a compact reddish brown clayey sand 4 to 6 inches thick underlain by stratified grey sand and gravel. The first two layers are moderately acid, the third nearly neutral and the parent material alkaline. In many places there are tongues of the reddish brown layer (B horizon) which extend downward for 2 or 3 feet into the grey sand below. The topography is smooth to slightly rolling. The surface soil consists of 85 per cent sand, 7·5 per cent silt and 7·5 per cent clay.

Chemical analyses of the Substation soil show the Fox sand to be moderately to slightly acid (pH 5·8 to 6·2), fairly low in organic matter (1·0 to 1·2 per cent), and total nitrogen (0·05 per cent), and to have a very low base exchange capacity (5·0 M.E./100 gm. of soil). The replaceable potassium is high for light sandy soils, 160 pounds per acre, but tobacco on this soil will respond to additions of potash. The exchangeable forms of calcium and magnesium which represent the major proportion of the available supply are found to be approximately 1,000 and 200 pounds per acre, respectively. These levels of calcium and magnesium appear adequate, although when the pH of the soil falls below 5·8 about 1,000 pounds per acre of dolomitic limestone is recommended for improving the availability of certain nutrients. The acid soluble phosphorus test shows about 40 pounds of phosphoric acid per acre. Although this figure may appear low, recent fertility investigations at the Substation have shown little response to additions of phosphorus on Fox sand which has been heavily fertilized with phosphate fertilizers in the past.

Some flue-cured tobacco is grown on the imperfectly drained Brady sandy loam and Berrien sandy loam soils. Water percolation is usually slow on these types because of a high water table or an impermeable clay layer. Good yields of fair quality tobacco are sometimes obtained on such soils when drainage is improved by tile drains and open ditches. Imperfectly drained soils respond to heavy phosphate and potassium fertilization but need lower amounts of nitrogen than well drained soils.

Fertilization of Flue-cured Tobacco

Where flue-cured tobacco is grown in Ontario a very definite fertilization program is needed to produce high quality, good yielding crops. The Tobacco Subcommittee of the Ontario Fertilizer Advisory Board have made comprehensive recommendations for the fertilization of flue-cured tobacco. Fertilizer manufacturers closely follow these recommendations in their fertilizer formulas.

At present the most popular analysis in the district is 2-12-10. The formulation has gradually come into practice through considerable experimentation at Delhi. A 3-8-4 analysis was generally used before the establishment of the Substation in 1933. The effect of the low percentage of potash was soon realized by deficiencies in the district and a 3-10-6 analysis became popular. In 1935 the nitrogen:potash ratio was increased from 1:2 to 1:4 by formulating a 2-10-8 mixture. The ratio was again changed to 1:5 in a 2-12-10 mixture in the early forties. Because of shortages of potash during the war this formulation has become popular only since 1948. The changes in fertilizer analyses undoubtedly have permitted the extension of tobacco growing under conditions hitherto considered unsuitable for this crop.

The efficient use of fertilizer is influenced by the amount and type of organic matter present, soil type, manure applications, and cultural methods. These factors should be considered in determining the fertilizer anaylsis and the rate of application. Flue-cured tobacco readily responds to variations in the nitrogen supply; small changes affect growth, maturity, quality, and yield. Too much nitrogen results in crops late in maturity and of inferior quality. Such crops lack body and color and are coarse and papery in texture. Phosphoric acid in fertilizers assists maturity if there is a deficiency in the soil, but phosphate additions often have little effect when there is an adequate supply. Tobacco utilizes a relatively large amount of potash in producing satisfactory quality and yield. Potash deficiency is indicated by yellowing and curling downward of the leaf tips. Cured leaf from tobacco deficient in potash is brittle in texture and difficult to case. Potash is supplied in the form of sulphate of potash, or a combination of sulphate and muriate of potash in the fertilizer mixture. While a portion of the potash may be supplied from water-soluble sources other than sulphate of potash, recommendations by the Tobacco Subcommittee call for not more than 2 per cent chlorine content in the fertilizer. An over-supply of chlorine causes poor burning qualities in cigarette tobacco. A high grade of dolomitic limestone, analyzing at least 19 per cent magnesia, is recommended in tobacco fertilizer not as a filler but as an ingredient to prevent magnesium deficiency, and to supply a portion of the calcium required by the tobacco crop.

Under normal conditions, 1,000 to 1,200 pounds per acre of fertilizer furnishes the required amount of plant food. Where more than 1,200 pounds is required for best quality and yield, a faulty cropping system is indicated. A 2-12-10 fertilizer is recommended for present varieties grown under average conditions and for the heavier flue-cured tobacco soils that have a fairly high natural organic-nitrogen content. A 2-10-8 fertilizer may be used to advantage on lighter soils provided the potash content is at a satisfactory level. A 3-10-8 fertilizer may be used to obtain greater size of leaf on some of the light soils that have been intensively cropped with tobacco. However, the need for additional nitrogen indicates that the soil organic matter has been partially depleted and should be corrected. Broadcasting additional phosphate and potash in low areas prior to transplanting often improves maturity. Lighter applications of 2-12-10 fertilizer are then necessary according to the fertility of the soil.

Table 17 outlines the estimated quantity of each nutrient required by a 1,500 pound per acre crop of good quality leaf and the amount supplied in a 2-12-10 fertilizer mixture.

TABLE 17.—APPROXIMATE NUTRIENT UPTAKE OF FLUE-CURED TOBACCO AND ADDITIONS IN FERTILIZER—1,500 POUNDS OF LEAF PER ACRE

Nutrient element	Leaf content (lb.)	Stalks and roots (lb.)	Total crop (lb.)	Amount supplied in 1,000 lb. 2-12-10 (lb.)
Nitrogen (N)	32	18	50	20
Phosphorus (P_2O_5)	7	5	12	120
Potassium (K_2O)	47	53	100	100
Magnesium (MgO)	16	10	26	20
Chlorine (Cl)	18	17	35	20

These data were gathered from work conducted at Delhi and from an article prepared by F. W. Parker "Flue-cured Tobacco Fertilizers of the Future", Commercial Fertilizer, March, 1952.

Although only 20 pounds of nitrogen is being added directly in the form of fertilizer, 32 pounds are removed by the leaf. The additional nitrogen is supplied by the organic matter, and by indirect fertilization of tobacco through the use of nitrogenous fertilizers on the rye straw the previous summer or by an application of barnyard manure. At present approximately ten times more phosphorus is being applied than is absorbed by the plant and seventeen times the quantity removed by the leaf. A considerable amount of the phosphorus becomes unavailable to the plant through fixation. Table 17 shows that one-half of the potash is returned to the soil through the roots and stalks which assists in balancing the potash in the soil.

TABLE 18.—THE EFFECT OF THREE FERTILIZER ANALYSES ON QUALITY, YIELD, RETURNS AND MATURITY OF FLUE-CURED TOBACCO, 1946–1951
(6-year average)

Fertilizer analysis (1,000 lb. per acre)	Grade index (¢ per lb.)	Yield per acre (lb.)	Returns per acre ($)	Maturity index
2–12–10	42·0	1,673	444	60·0
2–10–8	41·4	1,665	435	58·5
3–10–8	41·1	1,666	431	55·3

Table 18 shows a considerable difference in the maturity of flue-cured tobacco among the 2-12-10, 2-10-8 and 3-10-8 fertilizer applications. The 2-12-10 analysis produced the earliest maturing tobacco and still yielded the same as 2-10-8 or 3-10-8. This is important when growing tobacco in some of the new belts of Ontario where the frost-free periods are relatively short. The 2-12-10 fertilizer may be applied at a slightly lower rate than either 2-10-8 or 3-10-8 and still add equal quantities of phosphate and potash but less nitrogen. The maturity of tobacco depends largely on the amount of nitrogen available to the plant, with the other nutrients properly balanced in the soil. The 2-12-10 analysis also produced higher quality tobacco than either the 2-10-8 or 3-10-8. This, in addition to its effect on maturity, makes 2-12-10 an all-round fertilizer for most tobacco farms in Ontario, particularly since the introduction of rye fertilization.

TABLE 19.—THE EFFECT OF VARYING THE RATE OF FERTILIZER ON QUALITY, YIELD, RETURNS AND MATURITY OF FLUE-CURED TOBACCO, 1950–1952
(3-year average)

Fertilizer rates (lb. 2–12–10 per acre)	Grade index (¢ per lb.)	Yield per acre (lb.)	Returns per acre ($)	Maturity index
800	43·6	1,927	840	59·4
1,000	43·9	1,971	866	60·0
1,200	44·0	2,013	886	57·6
1,400	43·3	2,000	865	56·4
1,800	42·0	2,036	854	51·9

High rates of fertilizer tend to delay maturity and fail to produce higher returns per acre according to results obtained at Delhi. Best maturity was obtained by using 1,000 pounds of fertilizer per acre and as the rate was increased the maturity was delayed. Only a slightly higher yield was obtained by increasing the rate from 1,200 to 1,800 pounds per acre and the quality dropped 2 cents per pound. The amount of fertilizer to apply is largely governed by soil type. The soil on the Substation is medium compared to other soils in the district, therefore the results presented should be reviewed accordingly. Light soils normally require higher fertilization because of leaching while heavy soils require less because of higher fertility.

TABLE 20.—THE EFFECT OF FIVE RATES OF POTASH ON QUALITY, YIELD, RETURNS AND MATURITY OF FLUE-CURED TOBACCO, 1951-1952

(2-year average)

Pounds potash per acre	Grade index (¢ per lb.)	Yield per acre (lb.)	Returns per acre ($)	Maturity index
0	41·6	1,890	787	57·5
60	42·9	2,046	878	57·6
100	44·4	2,041	907	60·0
140	44·1	2,117	933	55·1
180	43·8	2,146	940	55·1
L.S.D. (·05)	1·5	101	62	N.S.

Table 20 shows significant differences in the effect of the various rates of potash on quality, yield and returns per acre. Optimum quality was obtained with 100 pounds of potash per acre, while higher levels produced outstanding yields and returns per acre. There was a tendency for the quality to drop where 180 pounds of potash per acre was applied. Although significant differences were not observed in maturity it would appear that 100 pounds per acre tended to hasten maturity while heavier applications caused a delay.

All tobacco soils in the district appear to respond to potash fertilization. Potash is fairly easily leached from sandy soils and needs to be constantly replenished. Potash imparts a resistance against drought and certain leaf diseases, and a liberal but not an over abundant supply is necessary for producing a high quality leaf.

TABLE 21—THE EFFECT OF VARIOUS RATES OF PHOSPHORUS ON QUALITY, YIELD, RETURNS AND MATURITY OF FLUE-CURED TOBACCO, 1951-52

(2-year average)

Pounds P_2O_5	Grade index (¢ per lb.)	Yield per acre (lb.)	Returns per acre ($)	Maturity index
0	42·6	2,269	967	58·5
60	44·6	2,223	991	57·9
120	42·8	2,231	955	60·0
180	43·9	2,205	968	58·7
L.S.D. (·05)	N.S.	N.S.	N.S.	N S.

Two-year results at Delhi show no significant difference among rates of phosphoric acid for either yield, quality, returns, or maturity. These results indicate there is a residual-phosphorus effect from previous applications of fertilizer. As only 12 pounds of phosphoric acid is absorbed by a 1,500-pound tobacco crop, it may be possible to reduce the application in some parts of the district without jeopardizing the quality. Some soils, as Burford sandy loam, require additional phosphate for hastening maturity and this addition is proving satisfactory without producing any apparent detrimental effect. Undoubtedly the need for phosphorus is greater on soils having more colloidal material because less "fixed" phosphorus is becoming available to the plant.

Starter Fertilizers for Tobacco

Several starter fertilizers have been used in the water at transplanting to determine whether they are beneficial for promoting root growth and improving the quality, yield, and maturity of tobacco. Soluble materials were used in the

mixtures and applied accordingly to the available nitrogen, phosphoric acid, and potash content. The figures under the treatments in Table 22 designate the actual number of pounds of available nitrogen, phosphoric acid, and potash applied per acre.

TABLE 22.—THE EFFECT OF STARTER FERTILIZERS ON QUALITY, YIELD, RETURNS AND MATURITY OF FLUE-CURED TOBACCO, 1951–1952

(2-year average)

Treatment pound per acre			Grade index (¢ per lb.)	Yield per acre (lb.)	Returns per acre ($)	Maturity index
N	P_2O_5	K_2O				
0	0	0	44·2	1,930	853	60·0
0	3	0	43·7	1,844	806	59·7
0	6	0	42·9	1,860	798	57·4
1	3	1	43·6	1,888	823	59·3
2	6	2	42·7	1,910	816	56·4
1	6	5	45·2	1,857	839	58·5

The results in Table 22 show no necessity for starter fertilizers in the water barrel for flue-cured tobacco. The check, water only, produced as good results as any other treatment. Past work conducted on the Substation also showed no advantage from starter fertilizers. In some instances starter fertilizers may be harmful, causing damage to the roots if applied too strongly.

Indirect Fertilization of Flue-cured Tobacco

Continued production of outstanding flue-cured tobacco crops depends on maintaining or improving the soil productivity by constantly supplying organic matter and essential elements. Organic matter increases the water-holding capacity of soils, retards the loss of valuable top soil by wind and water erosion, and reduces the leaching of plant nutrients. Organic matter in tobacco soils deteriorates rapidly through cultivation and therefore should be replenished between each tobacco crop.

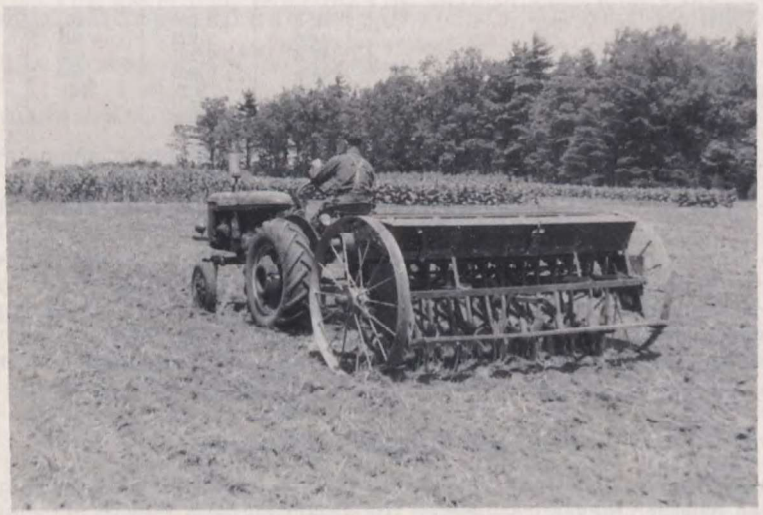

Figure 6.—Applying fertilizer to rye straw disked under in August.

Tobacco stalks, stems, rye straw, non-legume green manure crops and barnyard manure are suitable sources of organic matter and essential elements. Flue-cured tobacco during growth requires a low amount of nitrogen for producing good quality leaf, therefore legumes and direct high nitrogen fertilizer applications are undesirable. The rye-tobacco rotation usually provides sufficient plant residues but an additional supply of readily available nitrogen is required on the rye straw to hasten decomposition. Soil bacteria, the agents of decomposition, use carbon mainly as fuel, and nitrogen as building material for their bodies and for the production of the intricate organic compounds that result from their activity. The amount of increase in organic material corresponds to the amount of nitrogen available. In the absence of additional nitrogen rye straw decomposition tends to deplete the soil of nitrogen, thus reducing the tobacco yield. Commercial nitrogen fertilizers applied when the rye straw is disked under in August, have been used successfully throughout the tobacco growing areas in Ontario.

Barnyard manure was used extensively in the district for supplying organic matter, nitrogen and potash until recently when it has been largely replaced with rye and commercial fertilizer. Barnyard manure is expensive and has to be trucked from general farms in the district. Present recommendations are to apply ammonium nitrate (125 pounds per acre) or its equivalent when disking in the mature crop of rye during the month of August, reducing the need of barnyard manure. Potash is recommended in addition to nitrogen at the rate of 100 pounds per acre of muriate of potash where the soil is low in potash.

TABLE 23.—COMPLETE AND INCOMPLETE FERTILIZERS ON RYE STRAW IN AUGUST FOR TOBACCO, 1946–1948

(3-year average)

Treatment 500 lb. per acre	Grade index (¢ per lb.)	Yield per acre (lb.)	Returns per acre ($)	Maturity index
10–0–0	37·5	1,286	482	61·0
10–0–10	38·6	1,328	513	60·0
10–10–10	40·6	1,256	510	68·3

Results in Table 23 favor the use of potash in addition to nitrogen for rye fertilization. This increases both quality and yield of tobacco. Phosphate improved the quality but reduced the yield accordingly. A 10-10-10 analysis may be suitable on the heavier tobacco soils for producing earlier maturity.

TABLE 24.—SOURCES OF NITROGEN ON RYE STRAW IN AUGUST FOR TOBACCO, 1945–1948

(4-year average)

Sources (50 lb. N. per acre)	Grade index (¢ per lb.)	Yield per acre (lb.)	Returns per acre ($)	Maturity index
Ammonium Nitrate	38·4	1,342	515	60·0
Ammonium Sulphate	40·1	1,271	510	62·1
Sodium Nitrate	37·0	1,304	482	58·0
Calcium Cyanamide	35·8	1,355	485	54·8

The results presented in Table 24 indicate that ammonium nitrate produced favorable quality and yield of tobacco. Calcium cyanamide tended to lower quality and delay maturity, undesirable factors under Ontario conditions. A favorable nitrogen source is one that assists the decay of rye straw and yet has no effect on tobacco maturity.

TABLE 25.—COMPARISON OF BARNYARD MANURE AND COMMERCIAL FERTILIZER ON RYE STRAW IN AUGUST, ON FLUE-CURED TOBACCO, 1945–1952

(8-year average)

Treatment	Grade index (¢ per lb.)	Yield per acre (lb.)	Returns per acre ($)	Maturity index
5 tons barnyard manure per acre	40·4	1,624	656	60·0
500 lb. 10–3–10 per acre	41·9	1,626	681	63·8

In Table 25, 10-3-10 fertilizer analysis compared favorably with manure, producing the same yield per acre and slightly higher quality over a period of eight years. Commercial fertilizer is cheaper than manure and is much easier to apply. Since manure varies considerably in quality, a balanced fertilizer appears feasible in maintaining uniformity in tobacco production.

In 1951 a series of experiments were started to obtain further information on rye fertilization. Table 26 shows 1952 results on the latest trends on rye fertilization. The nitrogen was supplied by ammonium nitrate and the potash by muriate of potash.

TABLE 26.—COMPLETE AND INCOMPLETE FERTILIZER ON RYE STRAW IN THE ROTATION WITH FLUE-CURED TOBACCO, 1952

Treatment (lb. per acre)			Grade index (¢ per lb.)	Yield per acre (lb.)	Returns per acre ($)	Maturity index
N	P_2O_5	K_2O				
0	0	0	42·5	2,029	862	61·1
40	0	0	41·5	2,098	869	58·1
40	0	40	42·5	2,084	886	58·2
*40	20	40	44·2	2,118	936	60·0
40	40	40	41·4	2,052	850	58·6
L.S.D. (·05)			1·7	N.S.	47	N.S.

* (400 lb. 10–5–10 per acre)

Figure 7.—Rear cultivator on a tobacco transplanter.

The 1952 results favor the application of 400 pounds of 10-5-10 per acre. This treatment produced significantly higher grade index and returns per acre than where only nitrogen was applied. Although the yield was not significant among treatments there is a trend towards higher yield with the 10-5-10 analysis over no rye fertilization.

Cultural Practices for Flue-cured Tobacco

Several new cultural practices have been introduced since the publication of the last report. A pair of covering blades were invented at the Substation to replace the conventional packers on tobacco transplanters. A cultivator attached on the rear of a transplanter was tried with considerable success for cultivating immediately after transplanting. A rotary hoe has proved satisfactory for cultivating tobacco, one week to ten days after planting. Work on chemical control of suckers has been in progress since 1951. A new ridge ventilator for tobacco kilns was designed for the purpose of improving curing facilities in Ontario.

Covering Blades for Transplanting Tobacco

Very satisfactory trials have been conducted using covering blades instead of the conventional press plates or rollers on tobacco transplanters. Packing the soil mechanically can cause a severe set-back to the growth of plants unless they are immediately cultivated. Packing shoes, under moist conditions, tend

Figure 8.—Weeding tobacco with a rotary hoe.

to trowel the surface of the soil, which soon forms a crust. Packing the soil around the plant may also damage the stem, subjecting it to soil diseases. The new covering blades merely draw the soil into the trench and the plant is firmly set by the water, leaving the surface roughened, similar to a cultivator. The blades are constructed from 2- by ¼-inch flat iron, twisted and curved for drawing the soil to the plant. A large number are now being used with success throughout the district.

Cultivator Attachment for a Transplanter

To promote growth tobacco requires cultivating as soon as possible after being transplanted. Two small spring-tooth cultivators attached on the rear seats of a transplanter, are satisfactory for the first cultivation. The results are equally as good as those obtained by using a one-horse scuffler.

Rotary Hoe Cultivation

The centre space between the plants in the row should be cultivated soon after transplanting particularly if a crust forms on the surface. A rotary hoe may be used to advantage, without damaging the plants, for breaking the crust and discouraging weeds. Approximately 28 acres of tobacco may be cultivated in one day at an estimated cost of about 38 cents per acre. The plants should be fairly well established and the rotary hoe teeth should not extend more than 3 inches below the surface, working approximately one inch above the root crown. A high rate of speed, as high as 10 to 12 miles per hour, is important.

Sucker Control

Several tests using sucker controls, such as oils, oil emulsions, and maleic hydrazide, applied on tobacco at the time of topping, have been conducted since 1951. Because of a large variation in the results it is impossible to present data. In general, good control was obtained in 1951 using mineral oil emulsion at the rate of 2 c.c. per plant. However, in 1952, a considerable amount of stalk rot occurred, the result possibly of the hot humid weather following application. Injury was also observed at the leaf bases of some plants. Further investigations are necessary before any recommendations are made.

Figure 9.—Topping and applying oil for sucker control using an applicator.

Ventilating Flue-cured Tobacco Kilns

A new ridge ventilator was designed at the Substation to aid tobacco curing. A number of flue-cured tobacco growers have experienced difficulty curing the new high yielding varieties because of inadequate ventilation through the kiln during the early stage of drying the leaf. Many kilns in the district have little or no ridge ventilation, and curers depend largely on the gable end

doors for control. The end doors often supply insufficient top ventilation, particularly after the yellowing period when it is necessary to exhaust the warm moisture-laden air. The new ventilator provides an opening of twelve square feet across the entire ridge, which is divided into three controlled sections. The sides are raised ten inches above the roof creating a chimney effect for exhausting the air from the kiln. This ventilator is recommended on kilns where curing has been difficult. For best results, ample bottom ventilation should be supplied to balance the circulation of air through the kiln.

FIELD HUSBANDRY

Winter Rye Varieties

As winter rye plays an important part in maintaining the organic-matter content of the flue-cured tobacco soils of Ontario, several rye varieties have been tested at the Substation continuously since 1941. The results reported for the period 1946-1952 show considerable variation among varieties with regard to yield of grain, growth characteristics, and disease resistance. Recent studies of the roots, straw, and grain show that wide differences exist with regard to the organic material which is returned to the soil.

TABLE 27.—RYE VARIETY RESULTS OBTAINED AT DELHI, 1946-1952

(7-year average)

Variety	Yield bu./ac.	Height (in.)	Straw strength *	Days to maturity	Rust*		Dry matter lb./ac. 1951–52
					Stem	Leaf	
Prussian	19·5	50	3·2	297	3	4	10,360
Crown	17·7	54	1·6	298	5	4	10,385
Storm	17·4	50	2·6	298	4	5	8,780
Balbo	17·3	49	5·4	291	3	4	8,515
Imperial	17·1	53	2·8	295	4	5	9,591
Horton	16 6	55	2·6	293	4	5	9,130
Midsummer	14·5	52	3·0	300	4	3	8,060
Rosen	6·3	54	1·8	300	7	6	8,977

* Low figures indicate the least injury

Prussian produces the highest yield of grain and high yields of organic matter. This variety is not so tall as some other varieties tested but stools freely, and produces a sturdy, bushy plant.

Crown produces yields of organic material equal to that of Prussian, but slightly lower yields of grain. Crown is similar to Prussian in maturity and disease resistance, but grows slightly taller with weaker straw.

Storm is a fairly short variety with strong straw and produces above average yields of grain. The yield of organic material is fairly low in relation to the other varieties tested.

Balbo grows very short with fine straw which tends to lodge badly. The grain yield is fairly good but the yield of organic material is relatively low. This variety is not recommended for use in the flue-cured tobacco rotation.

Imperial is a fairly tall variety which is grown to some extent in the tobacco districts of Ontario. This variety produces good yields of organic material, fairly strong straw, and fair yields of grain, and is early in maturity.

Horton is the most commonly grown rye variety in the tobacco rotation in Ontario. This variety was introduced to tobacco growers by the Substation in 1945, and has achieved considerable popularity because of the tall straw and early spring growth. Tests show Horton does not produce as high yields of organic material and grain as some of the other varieties.

Midsummer produces low yields of grain and organic material and is not recommended in the tobacco rotation. Midsummer is rather late maturing, and produces medium short straw that is inclined to be weak.

Rosen produces medium yields of organic material. Partial spikelet sterility occurring in the seed used in the test resulted in low grain yields. This condition is unusual since Rosen usually produces fairly high yields of grain.

Prussian and *Crown* appear to be the most suitable rye varieties for use in a rye-tobacco rotation. Both varieties produce high yields of grain and organic material.

FIELD DAYS AND MEETINGS

Since the Substation was first established in 1933 a field day for flue-cured growers has been held each year in the latter part of July. This meeting affords an opportunity for growers, tobacco buyers and representatives of commercial firms to view the experimental work in progress on the Substation and to hear prominent speakers on tobacco and general agricultural trends in the district. During the period 1946-1952, the number attending this meeting increased from 1,800 in 1946 to nearly 3,000 in 1952. A winter meeting sponsored by the Delhi Chamber of Commerce was held in March 1952 and 1953. Colored slides were used to illustrate the talks which brought the latest information and experimental data to tobacco growers. Approximately 1,000 people attended each of these meetings.

LIST OF ACTIVE PROJECTS

Flue-cured Tobacco

Relation of Climate to Tobacco Culture
- Relation of rainfall to crop returns.
- Thornthwaite method of estimating soil moisture.

Fertilization of Flue-cured Tobacco
- Lime investigations.
- Methods and rates of applying fertilizer.
- Fertilizer nutrient levels (N-P-K).
- Rates of applying fertilizer on rye straw.
- Complete and incomplete fertilizers and manure on rye straw.
- Fertilizer formulae for varieties of flue-cured tobacco.

Topping and Suckering Tobacco
- Controlling sucker growth on tobacco.

Rotations, Rest Crops and Cover Crops
- Rotations with crop residues and barnyard manure.

Soil Analysis
- Changes in pH following liming.

Organic Matter Treatments for Tobacco Soils

The use of sawdust, straw, tobacco stems and manure as sources of organic matter.

Breeding New Strains of Tobacco

Breeding and selection for black root rot and brown root rot resistance.

Preliminary Test of Foreign and Domestic Flue-cured Tobacco Varieties

Hybrid tobacco studies.
Comparative variety test.

Tobacco Curing

Flue-curing tobacco in insulated and non-insulated kilns.
Flue-cured tobacco kiln ventilation.

Seed Production

Foundation stock seed production.

Field Husbandry

Rye Varieties

Testing winter rye varieties.

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OTTAWA, 1960