TOBACCO-GROWING IN SOUTHWESTERN ONTARIO

A SUMMARY OF TEN YEARS OF EXPERIMENT AT THE DOMINION EXPERIMENTAL STATION HARROW, ONTARIO

By D. D. DIGGES, B.A., B.S.A.
SUPERINTENDENT

DOMINION EXPERIMENTAL FARMS
E. S. ARCHIBALD, Director

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GROWING WARNE TOBACCO SEED AT THE HARROW STATION

The acreage devoted to the flue-cured type of tobacco has increased sixfold in the past ten years. A large part of the seed required has been produced by the Tobacco Division of the Experimental Farms system and distributed to growers through the Harrow Station.

Tobacco-Growing in Southwestern Ontario

A SUMMARY OF TEN YEARS OF EXPERIMENT AT THE DOMINION EXPERIMENTAL STATION, HARROW, ONTARIO

By D. D. Digges, B.A., B.S.A.,* Superintendent

INTRODUCTION

The Dominion Experimental Station for southwestern Ontario was evolved in 1923 from what was formerly the Harrow Tobacco Station and an additional one hundred and fifty acres of land added to its area. Many new lines of work were then started. Formerly this Station was engaged primarily in tobacco investigational work. During the past three years the program has been enlarged to include numerous experiments in other lines, but Harrow still remains the principal Station for tobacco investigations with the flue-cured, Burley and Green River types.

Although a marked improvement has been noted during the past ten years in the cultural methods of a large portion of the tobacco-growers, and although there has been a resultant improvement in quality, it is felt that we are not yet producing, on the average, either as high a quality or as large a yield of tobacco per acre as our natural advantages warrant. Since a further improvement in quality is greatly desired and would undoubtedly result in an increased demand from our home market and strengthen our hold upon our fast-developing export tobacco market; and since many of the experiments of the Station have resulted in both an improvement in quality and an increased yield of tobacco, it is felt that the publication of this report is justified.

THE PLANT-BED EXPERIMENTS

Types of Bed.—For the production of early, healthy seedlings, tests were made with the following types of bed:—

1. Cold bed, glass covered, fall steamed.
2. Cold bed, glass covered, spring steamed.
3. Cold bed, canvas covered, spring steamed.
4. Hot bed, glass covered, spring steamed.
5. Semi-hot bed, glass covered, spring steamed.
6. Semi-hot bed, glass covered, fall steamed.
7. Semi-hot bed, canvas covered, spring steamed.

Preparation of Beds.—In preparing the cold bed the original soil, a sandy loam, was simply worked up and well pulverized.

The semi-hot bed was made by digging out a trench about eight inches deep into which straw, cornstalks, or any such material was placed to a depth of six inches, after packing this well into the trench, about five inches of the soil which had been removed was placed on top of this material. The hot bed was made similarly, except that manure was used instead of straw or cornstalks.

After the beds had been made a top dressing of two inches of well-rotted compost was applied. This compost was obtained from a swampy bush and was practically nothing but a mass of rotted vegetable matter. The compost was hauled the spring before it was used and was turned several times during the summer to insure its being well sunned and aired.

* Mr. H. A. Freeman, M.Sc., succeeded Mr. Digges in the summer of 1926.

Fertilizing.—For several seasons applications of sulphate of ammonia alone, sulphate of potash alone, acid phosphate alone, and a ready-mixed commercial 3-8-4 fertilizer were made on portions of the beds before they were sterilized. Other portions of the beds received no fertilizer, and still other portions were sprinkled with a solution of 2½ pounds of nitrate of soda to 47 gallons of water, at the rate of 1 gallon of the solution to 18 square feet of bed, after the plants were up.

Sterilization.—Two methods for sterilizing the beds were tested out: with steam, and with formalin and other chemical solutions.

In sterilizing by steam, a galvanized iron pan or wooden pan six feet wide, twelve feet long and six inches deep was inverted over the soil after it had been well loosened and pulverized; the pan was then connected to a boiler in which the steam was under pressure of 100 pounds or more, and the steam turned on for 30 minutes. Some sections of the beds were steamed for 45 minutes and some for 60 minutes.

The formalin treatment consisted of sprinkling the bed with a solution of 1 part formalin to 50 parts water, at the rate of 1 gallon of the solution to 2 square feet of bed. The solution was put on in two applications 24 hours apart. After each application the bed was well covered with old bags to keep the fumes of the formalin in. Twenty-four hours after the last application, the bags were removed and the soil well loosened up to permit the fumes of the formalin to escape. The bed was ready to be sown as soon as the fumes had escaped.

A portion of each bed was left unsterilized for comparison.

The frames were placed around the beds as soon as they had been sterilized.

Seeding.—The beds were seeded about April 10, at different rates, with both dry seed and seed which had been sprouted. Both home-grown seed and imported seed were used. Dry sifted wood ashes was mixed with the dry seed, and rotten sawdust was mixed with the sprouted seed to act as carriers in sowing. After being sown the seed was covered by tamping the beds with a board and then sprinkling with water.

Watering.—The beds were always kept just nicely moist after being seeded but were never flooded. They were also well watered just before and after drawing the plants.

Shading.—Under glass the beds dried out rapidly on sunny days, while the plants were small. Since the plants are very easily killed by drying when they first come up, it was found beneficial to shade the bed somewhat by sprinkling the glass lightly with whitewash. However, this must be removed after the plants cover the ground with their leaves or there will be a tendency for the plants to grow spindling and be too tender.

Ventilating.—Since a change of air is absolutely necessary for the proper development of the plants and as a means of holding diseases in check the glass-covered beds were ventilated a little every sunny day; and if fair days occurred too infrequently, they were ventilated a short while, about noon, on cloudy days. The canvas-covered beds were also ventilated occasionally, especially on hot sultry days when there is danger of plants scalding if this precaution is not taken. However, in ventilating, the temperature of the bed was not lowered much below eighty degrees Fahrenheit if it could be avoided, for fear of checking the growth of the plants. Ventilation was increased as the weather became warmer and the plants increased in size.

Fig. 1.—A PROPERLY COVERED CANVAS BED

Note the raised centre. This type of bed usually furnishes hardy plants for late settings, and for replantings.

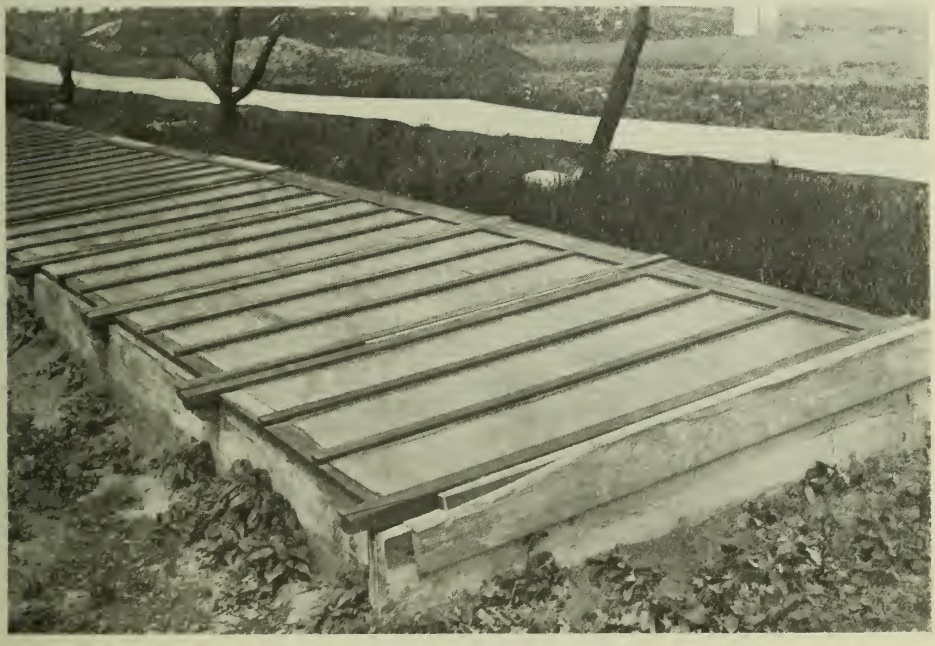

Fig. 2.—A GOOD TYPE OF BED FOR EARLY PLANTS

The semi-hot bed under glass furnishes an abundance of hardy seedlings at Harrow, ready for transplanting before June 1.

Control of Diseases.—The diseases of the seed-bed were usually eradicated by sterilizing the bed with steam. However, in some instances where the plants were a little too thick and the bed was kept a little too moist, bed-rot or damping-off disease would appear. This was then controlled by throwing out the infected plants and soil, giving all the ventilation possible, and allowing the bed to dry out for a day or so.

Seed Treatment to Control Seed-Borne Diseases.—For several seasons a portion of the tobacco seed sown has been treated with corrosive sublimate in an effort to determine its effect in the control of rusts and similar diseases.

In 1925 this experiment was conducted in co-operation with T. G. Major of the Tobacco Division and also included seed treated with Germisan, Uspulun, Semesan, Bayer Dust, Bayer Compound, Dupont Dust and Kalimat.

Since practically no rusts occurred on the Station the effect of the treatments on the control of such diseases could not be determined.

It was observed that the Dupont Dust apparently hastened germination slightly, while the corrosive sublimate, Germisan, and Uspulun apparently retarded germination slightly.

Hardening-Off.—About a week before the plants were to be transplanted, the bed was permitted to dry out somewhat, and the canvas or glass was removed during the day and even left off over night, if there was no danger of frost, in order to allow the plants to harden.

RESULTS AND RECOMMENDATIONS

1. The glass-covered beds always produced plants ready for transplanting about two weeks earlier than similarly-made canvas-covered beds.

2. During nine years the semi-hot bed has proved to be the most efficient type of bed tested.

3. For nine years the glass-covered semi-hot bed has produced plants from 7 to 13 days earlier than the glass-covered cold bed and it also produced a larger number of plants during the planting season.

4. The canvas-covered semi-hot bed produced plants just as early as the glass-covered cold bed and from 5 to 8 days earlier than the canvas-covered cold bed.

5. During nine seasons the fall-made and steamed cold bed proved just as efficient as the spring-made and steamed cold bed.

6. Six years' results strongly indicate that, by using straw, the semi-hot bed may be made and steamed in the fall without sacrificing its effectiveness, provided it is well covered.

7. Fall steaming of at least a portion of the seed-beds is recommended as a safeguard against late springs.

8. The value of the semi-hot bed lies in its ability to retain the heat absorbed for a longer period of time than the cold bed. The layer of straw or cornstalks stops the conduction of heat from the top layers of soil to the lower layers and, as a result, the semi-hot bed does not cool off as rapidly as the cold bed and frequently the temperature of the semi-hot bed remains from one to two degrees higher throughout the night than that of the cold bed.

9. The glass-covered hot bed produced plants from 3 to 5 days earlier than any other type of bed; however, the use of manure under glass is not advisable as towards the end of the growing season the combination of glass and manure supplies too much heat and the plants will not harden off properly and are usually spindling and too tender to give the best results when transplanted.

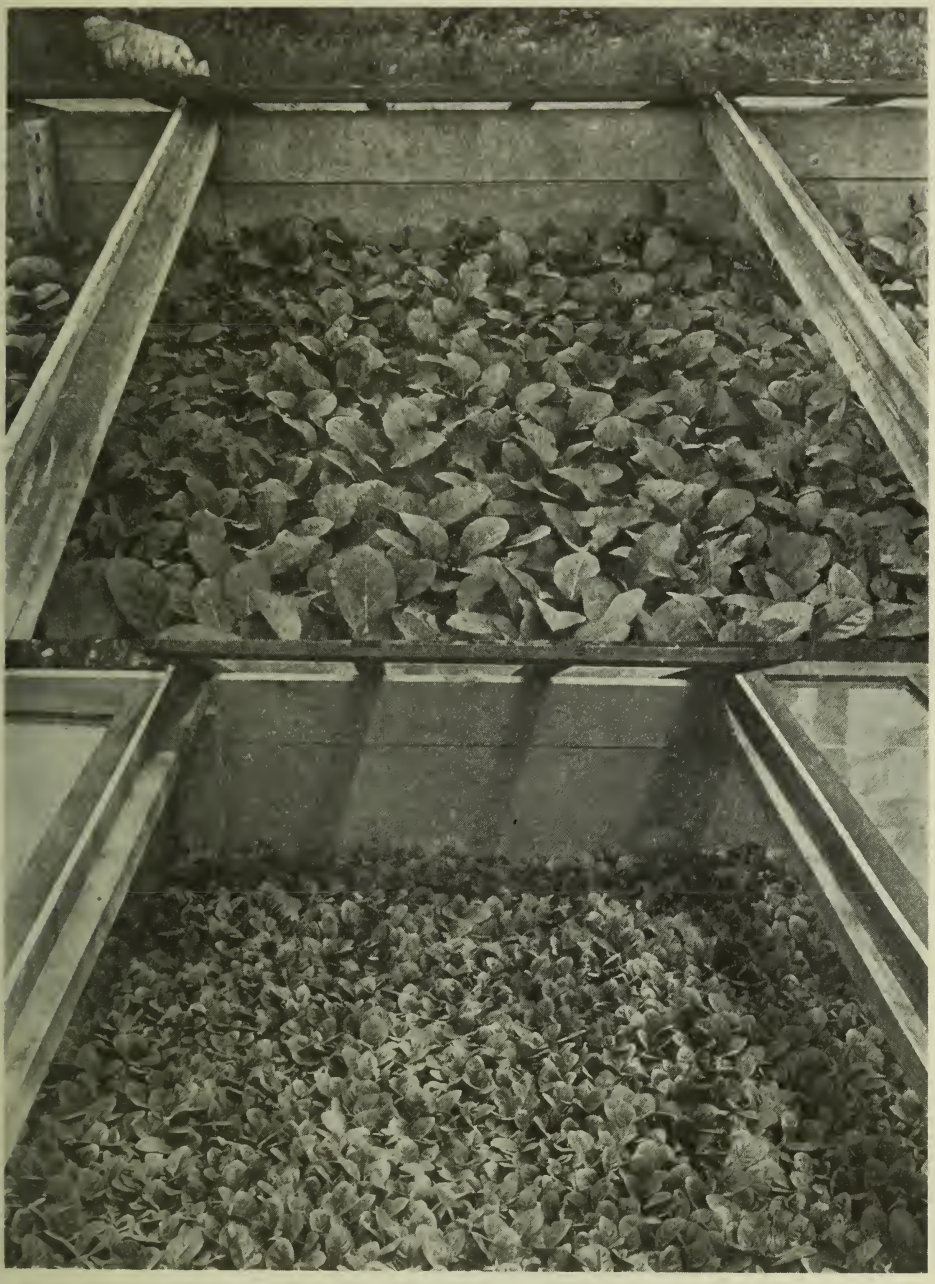

Fig. 3.—A COMPARISON OF GLASS-COVERED SEMI-HOT AND COLD BEDS.

(Above) Glass-covered semi-hot bed. (Below) Glass-covered cold bed.
In both beds the variety was the same, the date of seeding was the same, and the photographs were taken the same day.

10. Seven years' results have shown the use of the top dressing of black compost to be highly beneficial. It absorbs more heat and apparently holds the heat longer than the ordinary soil, does not pack too tightly for the proper development of the plants as a result of the continued watering of the beds, and produces plants from 5 to 10 days earlier than the ordinary soil.

11. Due to the prevalence of tobacco diseases, sterilization of the seed-bed is absolutely essential for the production of healthy plants.

12. The bed may be sterilized either with steam or with chemicals; however, as the use of chemicals leaves the soil in a waterlogged condition and kills very few weeds, steaming is superior to the use of chemicals.

13. During nine seasons steamed soil has produced plants from 7 to 21 days earlier than unsteamed soil and the plants grown on steamed soil were also more vigorous and robust than those grown on unsteamed soil.

14. Plants were produced 8 days earlier on steamed soil than on soil sterilized with chemicals.

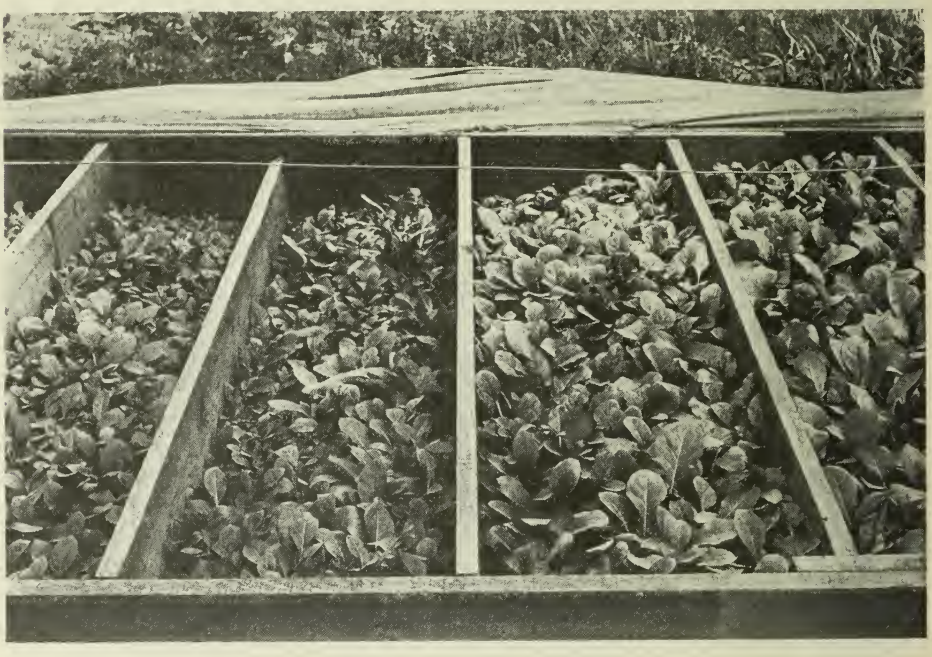

Fig. 4.—STEAMED SOIL GROWS EARLIER PLANTS

Note the differences in growth of the plants shown in this picture. The sections on the left were unsteamed while those on the right were steamed before sowing the bed.

15. Steaming for 30 minutes at 100 pounds pressure is apparently sufficient for weed and disease eradication. For the most effective results in steaming, the soil should not be very wet, the pan must be well banked to hold the steam in, and the frames should be put around the bed and the bed covered immediately after removing the steaming-pan.

16. While pressures lower than one hundred pounds finally raised the soil to just as high a temperature as at one hundred pounds pressure it took much longer for the lower pressures to raise the soil to the maximum temperature. Since the effectiveness of steaming depends not only on the temperature to which the soil is raised but also on the length of time it is held at the maximum temperature, the value of the high-pressure steam is easily recognized.

17. The steaming-pan should be just deep enough to allow a small space between the top of the soil and the top of the pan for the passage of the steam. If the pan is too deep the steam is not forced into the soil as rapidly as with a more shallow pan and there is a greater loss of steam by condensation. A pan six inches deep, twelve feet long and six feet wide has proven to be quite a satisfactory size.

18. Four years' results showed that dry seed when sown early in April produced plants just as early as sprouted seed, and since it is more difficult to get sprouted seed uniformly distributed over the beds and the risks with sprouted seed are greater than with dry seed, the use of dry seed is recommended.

19. The rate of seeding must be governed by the germinative power of the seed. If sown dry, Burley seed germinating 85 per cent should be sown at the rate of one-seventh of an ounce (or a slightly heaping teaspoonful) to one hundred square feet of bed. Due to a natural tendency to grow too spindling, the flue-cured varieties should be sown more thinly than the Burley varieties; at the rate of one-eighth of an ounce per hundred square feet.

20. For strong early plants the beds should be seeded by April 10 if possible.

21. Applications of potash alone or of acid phosphate alone apparently had no effect on the growth of the plants. Sulphate of ammonia alone and the commercial 3-8-4 hastened plant growth but not so much as the nitrate of soda solution. Apparently a fairly fertile soil, well supplied with humus, and the nitrate of soda solution, is the best combination for the production of plants.

22. The nitrate of soda solution must not be applied too frequently during the season, usually three applications are sufficient; with more the growth will be so rapid as to result in the production of a spindling watery plant of no value. The solution must be washed off the leaves immediately after applying, and it should not be applied before the leaves are as large as the little finger nail, as prior to that time the roots are apparently too few and small to utilize it.

ROTATIONS FOR TOBACCO

With the object of determining the best rotations to follow in tobacco-culture from the standpoint of the maintenance of soil fertility and the maintenance of both yield and quality the Station was subdivided into a large number of plots. These plots retained their identity from year to year and careful records were kept of the yields of all crops produced and of all fertilizers and manures applied to each plot.

Rotations for Flue-Cured.—For flue-cured tobacco the rotations tested were as follows:—

A. Four-year rotation of corn, tobacco, cereal and hay.
B. Four-year rotation of tobacco, corn, cereal and hay.
C. Five-year rotation of tobacco, corn, cereal and hay (2 years).
D. Five-year rotation of corn, tobacco, cereal and hay (2 years).

In rotations A and D eight tons of very strawy manure per acre were applied to the grass stubble to maintain the humus, while in rotations B and C the same application of manure was used on the tobacco stubble for corn.

The grass seed sown consisted of a mixture of timothy, red clover and red top; as a rule, there was very little clover in the hay.

Rotations for Burley.—For Burley the following rotations were tested:—

A. Three-year rotation of tobacco, corn and cereal.
B. Four-year rotation of tobacco, corn, cereal and hay.
C. Four-year rotation of corn, tobacco, cereal and hay.
D. Five-year rotation of tobacco, corn, cereal and hay (2 years).

In rotations B and D twelve tons of manure per acre were applied to the grass stubble for tobacco. In rotation C the same application of manure was applied to the grass stubble for corn. In rotation A the same application of manure was made to the oat stubble for tobacco.

Due to the existence of slight infections of root-rot on the Burley plots red clover was omitted from the grass mixture for the first five years and the grass seed sown was timothy and red top. After that the grass mixture consisted of red clover, timothy and red top.

Commercial fertilizer was used on both Burley and flue-cured tobacco in the above rotations.

Wherever possible winter-cover crops, or rye, were used in both the flue-cured and the Burley rotations to aid in maintaining the humus supply.

RESULTS AND RECOMMENDATIONS

1. Apparently all of the rotations are resulting in an increased fertility of the soil.

2. Apparently the increase in fertility is greatest in the five-year rotations and least in the three-year rotation.

3. The results indicated that a four-year rotation in which clover was omitted would eradicate slight infections of the root-rot.

4. The five-year rotation on flue-cured tobacco, in which tobacco followed hay, eventually resulted in the production of very heavy crops which were too coarse to cure satisfactorily, and it was abandoned. The other five-year rotation on flue-cured tobacco has not been under way long enough to justify deductions.

5. With flue-cured tobacco, the four-year rotation in which tobacco follows hay results in the production of a rather coarse type of tobacco.

6. From the standpoint of both yield and quality the best rotation for flue-cured tobacco is corn, tobacco, cereal and hay.

7. For Burley, from the standpoint of yield, the five-year rotation is best with the four-year rotation second best.

8. The four-year rotation apparently gives a slightly thinner and brighter-coloured leaf on Burley than the five-year rotation.

9. Preceding the Burley with corn apparently results in the production of a better-coloured leaf without very appreciably reducing the yield.

CONTINUOUS PLANTING OF THE SAME FIELD TO BURLEY

In order to determine the effect of continuously cropping land to tobacco, one plot on the Station has been planted to tobacco continuously for ten years. In 1916 and 1918 Broadleaf Burley was the variety grown; in 1917 Gold Leaf was the variety grown; and during the balance of the seasons it was planted to Resistant Burley. This plot has received applications of one thousand pounds of fertilizer per acre and twelve tons of manure per acre each year and has generally been sown to a cover-crop of rye.

In arriving at conclusions regarding the effect of continuous cropping the yield and quality of the tobacco grown on this plot has been compared with the yield and quality of the tobacco produced on a set of four plots just opposite it. The soil of the set of four plots was practically the same as that of the continuously planted plot; however, a four-year rotation was followed on the four plots and they received the same application of manure and fertilizer but once in four years that the continuously planted plot received every year.

For the first four years there was an increase in yield each year on the continuously planted plot; since that time there has been not only a decided decrease in yield each year but the percentage of tobacco infected with mosaic disease and leaf-rusts has shown a great increase and the quality of the tobacco has also deteriorated to a marked degree. The soil of this plot is now infected with the root-rot.

On the set of plots, on which the four-year rotation is being followed, which are used for comparison there has been an appreciable and fairly uniform increase in yield and a decided improvement in quality each year.

Since the soil of the plot continuously planted to tobacco can not be lacking in fertility, and since frequently it is the only plot on the Station which shows any appreciable amount of diseased tobacco, this experiment clearly demonstrates that, regardless of the fertility of the soil and the amount of fertilizer used, a good rotation is necessary if the maximum yield and the best quality of tobacco is to be obtained.

SPRING PREPARATION OF THE SOIL

All land for the production of tobacco was well broken and pulverized with the disk and harrows. The rows were then laid off at the desired width and the fertilizer drilled into the rows. Then the fertilizer was covered with a ridger which left the rows slightly elevated above the surrounding soil, minimizing the danger of the young plants being drowned should a period of wet weather occur. This ridge was gradually worked down during the process of cultivation until the land was practically level again.

Before being broken, practically all land for the production of Burley had an application of twelve tons of manure per acre.

Past results strongly indicate that tobacco land should be ploughed very early in the spring in order that a good supply of moisture may be taken up and stored for the use of the crop.

FALL PLOUGHING VS. SPRING PLOUGHING FOR BURLEY

Each fall two plots were manured for the tobacco crop to be grown on those plots during the following season. Sometime after the first of October

Fig. 5.—BURLEY TOBACCO ON FALL- AND SPRING-PLOUGHED LAND

The value of fall ploughing for tobacco is shown in this picture. The centre of this picture is the dividing line between the spring- and fall-ploughed plots. The rows to the right of the centre are on fall-ploughed land, while those to the left are on spring-ploughed land. All this tobacco was planted the same day.

one half of each of those plots was ploughed, the other half remaining in sod. The following spring each of the fall-ploughed sections was disked twice, at different intervals, the last disking constituting the preparation necessary for planting; the sections remaining in sod were ploughed and disked once as a preparation for tobacco. The tobacco on each section of these plots was uniformly fertilized, planted on the same day, uniformly cultivated, harvested on the same day, and every precaution was taken to make the time of ploughing the only factor affecting the yield. When the tobacco was harvested the crop on each of the fall-ploughed sections was tagged and kept separate from that on each of the spring-ploughed sections until after it had been stripped and weighed.

The results of this experiment will be found in the following table:—

TABLE I—A COMPARISON OF FALL AND SPRING PLOUGHING FOR BURLEY AT THE HARROW EXPERIMENTAL STATION FOR THE YEARS 1917 TO 1925 INCLUSIVE

Plot No.	Size of plot	Treatment	Yield on plot	Gain per acre	Value of gain per acre	Year
			lb.	lb.	$ cts.	
1	0·75 acre	Fall ploughed	1,294· ½	298·0	68 54	1917
1	0·75 "	Spring "	1,071·0			1917
2	0·75 "	Fall "	1,096·0	277·0	63 71	1917
2	0·75 "	Spring "	888·0			1917
3	0·75 "	Fall "	891·5	251·0	87 85	1918
3	0·75 "	Spring "	703·0			1918
4	0·74 "	Fall "	620·0	67·6	23 66	1918
4	0·74 "	Spring "	570·0			1918
5	0·49 "	Fall "	915·5	55·0	24 20	1919
5	0·49 "	Spring "	888·5			1919
6	0·44 "	Fall "	774·0	458·0	68 70	1920
6	0·44 "	Spring "	572·0			1920
7	0·74 "	Fall "	1,293·5			1920
7	0·74 "	Spring "	1,409·0	156·0	23 40	1920
8	1·0 "	Fall "	2,358·0	47·0	9 40	1921
8	1·0 "	Spring "	2,311·0			1921
9	1·0 "	Fall "	1,073·6	151·6	30 32	1922
9	1·0 "	Spring "	922·0			1922
10	1·0 "	Fall "	1,500·0			1923
10	1·0 "	Spring "	1,660·0	160·0	64 00	1923
11	1·0 "	Fall "	1,225·0	154·0	30 80	1924
11	1·0 "	Spring "	1,071·0			1924
12	1·0 "	Fall "	1,700·0	80·0	16 00	1924
12	1·0 "	Spring "	1,620·0			1924
13	1·0 "	Fall "	1,532·0	46·0	12 65	1925
13	1·0 "	Spring "	1,486·0			1925
14	1·0 "	Fall "	1,488·0			1925
14	1·0 "	Spring "	1,558·0	70·0	19 25	1925

RESULTS AND RECOMMENDATIONS

1. During seven out of nine seasons fall ploughing proved more profitable than spring ploughing for Burley. For the entire period the average yield on fall ploughing exceeded that on spring ploughing by 107 pounds per acre.

2. The profit derived from fall ploughing was even greater than the increase in value of the crop obtained if we take into consideration the facts that ploughing can be done more cheaply in the fall than in the spring; that fall ploughing serves to give a more even distribution of labour; and that ploughing after October 1 is a fairly effective means of combatting the cutworm. Much less trouble from the cutworm was experienced on the fall-ploughed sections of the plots than on the spring-ploughed sections of the same plots.

TRANSPLANTING TOBACCO

The bulk of the crop was transplanted by machine each season from May 24 to June 18.

By a comparison of the yields obtained on various plots, in which fertility and other factors were practically the same, it was shown that, where seasonal differences were not too great, the earlier-planted plots practically always yielded a heavier crop than the later-planted plots.

In practically every instance the earlier-planted plots also produced tobacco of a better colour and quality than the late-planted plots.

Three years' results strongly indicate that the planting date has a very marked effect on the quality of the air-cured Green River type of tobacco. This type yellows more slowly and with greater difficulty than the Burley and late planting and harvesting combined with a poor, cool curing season resulted in very unsatisfactory cures.

Tests of different distances for transplanting the various types of tobacco indicated that for both yield and quality the best distances for transplanting are as follows:—

Flue-cured tobacco	24	inches by	36	inches
Broadleaf Burley	28	"	44	"
Standup Burley	28	"	42	"
Yellow Pryor	31	"	44	"
Greenwood	28	"	44	"
Little Hill	28	"	44	"

In these tests it was observed that more widely spaced planting tended to produce a larger and coarser type of plant and to reduce yield as compared with closer planting.

CULTIVATION AND TOPPING

The cultivation of the crop was begun from eight days to two weeks after transplanting. It proved advisable not to cultivate too closely around the plant until it had taken root as there is danger of killing it. Apparently the best results were obtained by making the first cultivation about six inches deep and making each subsequent cultivation more shallow until towards the last not more than a two-inch depth was reached. Usually, cultivation was stopped as soon as the tobacco had been topped as it has been found that cultivating after topping delays ripening.

In topping, the results showed that this operation should be performed as soon as the majority of the plants have developed the desired number of leaves. The results showed that postponing topping until a large number of the plants had developed flower-stalks retarded ripening, increased the proportion of stalk to leaf, reduced the yield and, therefore, cannot be too strongly condemned.

CONTROL OF INSECT ENEMIES

CUTWORM

Five methods for combatting the cutworm were tested on the Station, namely:—

1. Dusting the plants after transplanting with dry powdered arsenate of lead, mixed with an equal weight of sifted wood ashes as a carrier.

2. Spraying after transplanting with a solution of paste arsenate of lead and water, three ounces of the paste per gallon of water.

3. Spraying the plants before transplanting with a solution consisting of $1\frac{1}{2}$ ounces of dry arsenate of lead per gallon of water. The plants should be sprayed in time for them to dry before being set out.

Fig. 6.—THE EARLY TOPPING STAGE

Early topping has consistently given the best results at the Harrow Station. The stage shown here, with the flower bud just showing, is ideal. Note the discarded lower leaves on the ground between the rows. At topping time all flue-cured tobacco should be gone through and the ground leaves primed off and discarded.

Fig. 7.—A YIELD OF PROPERLY TOPPED HICKORY PRYOR

Note the well-developed top leaves, and the uniformity shown in all the leaves. The field shown here is nearing maturity.

4. Applying a poisoned bran mixture broadcast on the field after transplanting, mixed in the following proportions:—

Wheat bran	50 pounds
Paris green	1 pound
Molasses	1 gallon
Water	1½ gallons

5. Ploughing after October 1.

RESULTS.—1. All of the methods gave better results than no treatment.

2. The poisoned bran mixture was the most satisfactory method of control when sown broadcast late in the afternoon two or three days before transplanting. Two light applications of the poisoned bran on successive days proved more effective than one heavy application.

3. Of the arsenate of lead treatments, spraying the plants before transplanting was the most satisfactory. However, plants which are to be held over, after pulling, from one day to the next should not be sprayed until they are to be transplanted.

4. In many seasons fall ploughing has proven to be the only control measure necessary and in every season fall ploughing reduced cutworm damage very appreciably.

THE HORNWORM

The most effective and economical method for combating the tobacco hornworm was found to be spraying with arsenate of lead. This may be applied either in solution or in the powdered form. Until the tobacco is about half-grown it

Fig. 8.—SPRAYING TOBACCO FOR THE HORNWORM

The machine shown here was devised and used at the Harrow Station, and has given excellent results. It sprays four rows at a time. The high wheels make it possible to use this machine until close to topping time.

can be sprayed very effectively with the solution in a spray cart which sprays four rows simultaneously. For this six pounds of powdered arsenate of lead to one hundred gallons of water is usually sufficient. A very efficient two-row spray-cart devised and used at this Station is shown in fig. 8.

After the tobacco becomes larger the top and middle leaves so nearly cover the bottom leaves as to render the cart and solution ineffective. It is then that the dust-gun proves its value. For use in the dust-gun the powdered arsenate of lead is mixed with an equal quantity of dry sifted wood ashes, or air-slaked lime if the ashes are not to be obtained. The powder is then applied early in the morning while the dew is on the tobacco, the operator holding the nozzle of the dust-gun at such an angle as to bring it about the middle of the plant. For tobacco nearing maturity, 6 pounds of arsenate of lead is required per acre; for smaller tobacco 4½ pounds usually suffices. In each case an equal quantity of ashes was used. This insecticide not only kills all the worms then on the tobacco but continues to kill all which hatch for several days after it is applied.

There are several forms of arsenate of lead on the market and as all are not suitable for spraying tobacco the grower should demand the form having a guaranteed analysis of not less than 30 per cent arsenic oxide, of which not more than one per cent is water-soluble.

DISEASES OF TOBACCO

MOSAIC

The mosaic disease commonly known as "Calico," and by various other local names, has been quite prevalent in the tobacco crops some seasons; being most common in rather wet years or in low wet regions in the fields. It is very infectious and a large number of healthy plants can be infected from a single diseased plant in the operations of topping and suckering. Since this disease attacks the youngest, fastest growing parts of the plant, it is generally most in evidence on the top leaves, giving them a characteristic mottled crinkly appearance. Its presence is indicated after curing by the lack of elasticity of the leaf.

In an experiment conducted to determine the ability of tobacco seed to transmit the disease to plants produced therefrom, the seed of a mosaic plant was sown and after the resulting plants had developed sufficiently they were transplanted to the field. Apparently these seedlings were entirely free of the disease as not a single plant showed signs of being infected throughout the growing season.

In an experiment conducted in co-operation with Mr. G. C. Routt, relative to the infectivity of the mosaic disease, all of the diseased plants were pulled out of some plots of tobacco early in the season, while in the other plots no infected plants removed. The number of infected plants was recorded in each and before harvesting the plots a second count of diseased plants was made. During the topping and suckering operations care was taken not to infect the plants in the plots from outside sources. The results of the counts indicated that mosaic can be held in check by pulling out the diseased plants early in the season.

The disease may be carried over from year to year in infected leaves and stalks.

Methods of control consist of using only fresh soil for the production of plants, sterilizing seed-beds, rotating crops, and where a field is not too badly infested, pulling up the diseased plants as soon as discovered.

ROOT-ROT

The black root-rot, caused by the fungus *Thielavia basicola* (B. & Br.) Zopf, has been quite prevalent in the tobacco fields of some districts. Although all plants set out on the Station had good healthy root systems some of the fields were badly infested prior to the 1920 season.

This fungus attacks the entire root system but is generally more in evidence on the young fibrous roots, causing them to decay. These roots then

cease to function as food carriers and as a result the plant is starved. The degree of starvation depends upon the extent to which the field and plants are affected, the climatic conditions prevailing at the time of transplanting, and the robustness of the plants. Some plants died, but with the majority the roots apparently functioned just long enough before becoming diseased to keep the plant living, but not long enough to enable it to make any growth. The diseased plants generally remained small until late in the season, when they began to grow. Such plants, however, rarely attained the size of a normal plant and were usually harvested green.

This disease attacked the plants both in the field and in the plant-bed. In the plant-bed, the diseased plant usually had a yellow unthrifty appearance and its growth was comparatively slow, though this was not always the case. Often upon examination, plants which had a good colour and were making a satisfactory growth in the bed were found to be infected. In the field, the diseased plants were small and unthrifty, and often such infested fields presented a checkered appearance, due to several small plants being followed by large healthy ones. In either case, upon carefully pulling up the plant and examining the fine roots, it would seem that the latter had turned black and were decayed. After the plant had become infected no amount of cultivation or fertilization appeared to be of value in starting it to grow. However, when healthy, robust plants were transplanted on slightly diseased fields which had been thoroughly prepared, and the climatic conditions were favourable for a quick growth, the plants were apparently capable of resisting the disease and making a nearly normal growth. On the other hand, a continued wet spell or anything which tended to weaken or check the growth of the plant apparently lessened its resistance to the disease, and the degree of infection was increased.

Methods of control consisted of sterilizing the plant-beds thoroughly; not using the same soil for the production of plants too long; rotating of crops; and stopping the culture of red clover on fields known to be infected. No plants should be used from a diseased bed, as the use of diseased plants will spread the disease over an entire field in a short time.

Our results indicate strongly that light infestations of root-rot can be eliminated by employing a four-year rotation in which red clover is omitted.

BED-ROT OR DAMPING-OFF

The rotting or damping-off of the young seedlings in the plant-bed is caused by fungi which spread very rapidly. The plants attacked by this disease usually began to rot near the surface of the ground, the infection in some cases spreading on up the stalk until the entire plant was decayed. Infected plants usually bend over, wilt and die; though some may partially recover, giving evidence of the attack by a brownish deadened area on the stalk near the root. Such plants should be discarded as they seldom prove satisfactory when transplanted. The disease was most prevalent in thickly seeded beds which were very moist and lacked ventilation.

Sterilization of the bed and thin seeding were the most effective methods for preventing the disease. After it occurred it was checked by throwing out the infected plants, lowering the temperature by thorough ventilation, and allowing the bed to dry out for a time. In warm rainy weather it was very difficult to check, and at all times the best method of control was preventive.

HARVESTING

For ten seasons the split-stalk method of harvesting has been compared with the spudding or needling method as regards the effect on the rate of the cure and the colour and quality of the cured tobacco. Invariably splitting the

stalk and straddling the plant on the lath has proven superior to needling the plant on the lath. Splitting the stalk shortened the curing period from two or six weeks, depending on the type of curing season; lessened barn damage; generally gave a brighter-coloured leaf and eliminated swelled stems.

Fig. 9.—HARVESTING FLUE-CURED TOBACCO BY THE SPLIT-STALK METHOD.

Tobacco harvested in this way cures much more rapidly and easily, thereby eliminating swelled stems, and materially improving the quality of the cured leaf.

SCAFFOLDING VS. DIRECT CURING OF BURLEY

Plots of Burley were scaffolded in the field immediately after being harvested for different periods of time and compared with Burley cut at the same time and hauled to the barn as soon as wilted. It was found that Burley could be scaffolded in the field safely for about three days, in fair weather, and a little quicker and brighter cure obtained than when the tobacco was hauled immediately to the barn. After this three-day period the tobacco began to take on a weather-beaten appearance and redden up considerably.

The chief value of scaffolding tobacco in the field lies in the fact that it is a great saver of time and of barn space. The tobacco becomes thoroughly wilted on the scaffold and can be placed much closer together in the barn without danger of pole-burn; and it can be left out over night without suffering much injury from the dew and be hauled to the barn in the morning before the other tobacco has dried off sufficiently to go on with the harvesting.

EXPERIMENTS WITH HEATING APPLIANCES FOR CURING TOBACCO

These experiments included tests of the Johnson Patent curing furnace, the Beckett-Covill single furnace, the Beckett-Covill twin furnaces, the Canadian Oliver No. 60 fuel-oil burner, the old-fashioned brick furnaces. high-pressure steam for flue-curing tobacco; and charcoal salamanders for curing Burley.

The Johnson Patent Curing Furnace was a comparatively small iron furnace which burnt either coal or wood. Since it was a single furnace it had to be installed in the centre of one foundation wall, and the main heat-conducting pipe ran down the centre of the kiln. Since it is much more difficult to maintain the desired temperature around the sides of the kiln than in the centre it was found that the principle of curing by a single furnace is fundamentally wrong. It was also found that with any single furnace there was a tendency for the heat to strike too hard and cure out too much green in the tobacco just over the furnace; that the fire-risk was considerably greater than with twin furnaces; and that the single furnace required more attention to maintain the desired temperature than twin furnaces. Two years' results showed that the Johnson furnace was too small to satisfactorily cure stalk-cut tobacco under Ontario conditions.

With the exception of being larger and having a larger air space between the fire wall and the exterior wall of the furnace, the Beckett-Covill single furnace was quite similar to the Johnson furnace in construction. To some extent the same difficulties were encountered with both furnaces; however, due to its larger fuel-holding capacity, the Beckett-Covill furnace proved much more satisfactory than the Johnson furnace. With the exception of setting a little too much green just over the furnace and the first two lengths of pipe, the colour of the tobacco cured with this furnace was quite satisfactory.

Generally, soft coal proved to be the most satisfactory fuel with either of the single furnaces; however, at certain stages in the curing process a combination of coal and wood gave the best results. Fuel-costs were lower with the iron furnaces than the brick wood-burning furnaces.

The Beckett-Covill twin furnaces are somewhat smaller than their single furnace, otherwise their construction is practically the same. One year's results indicate that the twin furnaces are considerably better than the single furnace from the standpoints of maintaining a uniform temperature and lessening the fire-risk. Apparently the fuel requirements of the twin furnaces and the single furnace will be approximately the same. Since it was not necessary to force the twin furnaces as hard as the single furnace to maintain the desired temperature, the costs of repairs should be considerably reduced with the twin furnaces.

Experiments with the Canadian Oliver fuel-oil burner proved very satisfactory. Fuel-oil gave a more uniform temperature throughout the kiln and a somewhat more satisfactory colour than either wood or coal. However, the fuel-cost with oil was very much higher than the cost with soft coal and also higher than the cost with wood.

In testing high-pressure steam as a source of heat for flue-curing tobacco the equipment consisted of a 30-horsepower locomotive-type boiler and kilns equipped with a series of coils made up of $1\frac{1}{4}$ inch black pipe serving as radiators. While full data as to the economy of this method of flue-curing tobacco are not yet available due to the impossibility of running the system at full capacity in the past, even under that handicap steam-curing has proven more economical than any other system, with the possible exception of coal-burning furnaces, during four years' experiments. Steam gives a more uniform temperature throughout the kiln and a more uniform cure than any other source of heat and entirely eliminates fire-hazard.

The use of charcoal salamanders in the Burley barns during continued wet muggy periods of weather proved very beneficial in preventing pole-burn, hastening the cure and improving the colour of the leaf. Fires built of corn cobs or any smokeless material would also prove very beneficial.*

* More detailed information on curing equipment may be found in Pamphlet No. 51, "Heating Appliances for Flue-Curing Tobacco."

THE RELATION OF THE RELATIVE HUMIDITY IN THE CURING-BARN TO THE COLOUR OF THE CURED LEAF

Careful records have been kept, by using hygrometers, of the relative humidity in the flue-curing barn at the various stages in the curing process with the object of determining what the humidity should be at the various stages in order to get the most satisfactory colour. The results have varied somewhat due to the great variations experienced in the climatic conditions and character of the tobacco from year to year. However, the results have demonstrated that the humidity should be lowered more rapidly towards the end of the yellowing process with large heavy-bodied tobacco than with tobacco of medium size and body. The averages of five years' results indicate that in general the relative humidity should be 74 per cent when the lugs begin to yellow, 66 per cent when the middles begin to yellow, 58 per cent when the tips begin to yellow and 46 per cent when the tobacco is about yellow enough for fixing the colour.

THE EFFECT OF RIPENESS ON COLOUR

Close observations have shown that the best cured leaf colour is usually obtained with tobacco which is fairly ripe. Burley may be harvested slightly immature with less danger of marked deleterious effects than either the flue-cured or the Green River types.

HOME-GROWN VS. FOREIGN-GROWN TOBACCO SEED

An experiment was conducted with both home-grown and foreign-grown seed of Halley's Burley, Broadleaf Standup Burley, Station Standup Burley, Judy's Pride, Hopes Standup Burley and three varieties of flue-cured tobacco (Warne, Gold Leaf and Flannagan) with the object of determining what difference there would be between the development and maturing of plants produced.

Not only did the plants from the home-grown seed ripen earlier than those produced from foreign-grown seed but they also ripened more uniformly.

GROWING TOBACCO SEED

Large quantities of tobacco seed of the different varieties were produced on the Station. In producing this seed large numbers of plants were selected and the seed-heads bagged just before the first flowers opened. In bagging the seed-heads all leaves, suckers, and lateral branches were removed from the top of the plant until only the crow-foot was left. This was then covered with a 14-pound manila bag, the mouth of which was tied around the stalk just below the lowest remaining branches. At two later selections the original number of plants selected was reduced until only the best type of plants of the variety desired were left. About every three weeks the bags were removed, the suckers and fallen blossoms cleaned out, and the bags replaced. When the pods were about one-half grown the bags were removed and all late flowers, buds, and capsules were cut off. Removing the bags, after the capsules have formed, aids in maturing the seed-heads earlier.

The seed-heads should be harvested as soon as the pods turn brown, preferably before frost, and hung up in a barn to cure for about two months; after this the seed should be shelled out, cleaned, and stored in a dry place in some container which will exclude the mice and insects but which will admit the air.

It requires about thirty-five plants, trimmed up as previously described, to produce one pound of seed.

Since it was found that the use of heavy yellow paper bags resulted in a curtailment in the quantity of seed produced and lowered the germination of the seed, the use of white bags is strongly advised.

STEAMING TOBACCO INTO CASE

Often, during the curing season, after a kiln of tobacco has been cured we do not have suitable weather to bring the tobacco into case; and frequently it is necessary to empty the kiln in order to care for other tobacco which has not been cured.

While no method has been found for bringing tobacco into case which gives, altogether, as satisfactory results as a natural casing season, steam has been found to be fairly satisfactory substitute.

In bringing the tobacco into case by this method it is necessary to have the kiln absolutely cold; i.e., all heat generated during the curing process must be disposed of. Then steam at a low pressure, not over twenty-five pounds, is carried into the kiln through a hose or pipe. By moving the hose from place to place the whole kiln is brought into case. Care must be taken in this procedure to prevent getting the tobacco too high into case. It should be steamed only until the leaf is pliable enough to handle without breaking. To steam until the whole midrib is pliant would be running a chance of turning the whole leaf red. As soon as the tobacco can be handled without breaking, it should be taken down as it will dry out very fast when it has been steamed into case.

Tobacco can also be brought into case for stripping by the above procedure.

Fig. 10.—WARNE FLUE-CURED TOBACCO AT THE HARROW STATION

A promising field of Warne at the Harrow Station in 1925. This variety has given the best flue-cured tobacco at Harrow, and is recommended for the general run of flue-cured soils.

VARIETY TESTS OF FLUE-CURED TOBACCO

During the past ten years, twenty varieties of flue-cured tobacco were tested on the Station. According to the shape and size of the leaves they may be roughly divided into two classes, namely, the broadleaf and the narrow-leaf types. As a rule, the broadleaf types were slower in maturing, darker in colour when cured, and coarser than the narrow-leaf types, and when both types were planted the same distance apart, the broadleaf types were the heavier yielders.

The broadleaf varieties grown included: Souths, Duke, Cash, Tilley, Lizzard Tail, Long Leaf, Gooch, Conqueror, Adcock, White Stem Oronoco, Willow Leaf,

Rich Wonder, Granville County Yellow, Turkirish, Gold Leaf, Warne, Hester, Hickory Pryor and Critcher. Of those the Lizzard Tail, Gooch, Conqueror, Adcock, White Stem Oronoco, Gold Leaf, Willow Leaf, Rich Wonder, Granville County Yellow and Hester grew very rank and coarse, and while they were good yielders they failed to cure satisfactorily due to their heavy body. Souths, Duke and Cash yielded and cured rather indifferently and as they were rather slow in maturing they have no particularly commendable qualities. Hickory Pryor, Critcher, and Tilley have somewhat similar characteristics. They cure with a bright flashy face and although not as good yielders as the Warne they are fairly good yielders. Of the three the Hickory Pryor is the most promising variety, and on soils which are slightly too heavy or too fertile for the flue-cured type of tobacco it will frequently give a better product than any of the above varieties. However, it is apparently the most susceptible of these varieties to rusts and other leaf diseases and in poor seasons it frequently becomes very badly diseased. Of all the varieties tested the Warne is apparently the best variety for the general run of soils in the flue-cured district.

The Turkirish produced coloury but very thin leaves and was a very light yielder.

The narrow-leaf varieties tested included Flannagan and Gopher Skin. Of the two the Flannagan produced the smoothest, largest, best coloured leaves and the best yield. The results indicated that on the heavier soils, if planted a little closer than the broadleaf types, it would yield well and possibly give a better quality than the broadleaf varieties.

TESTS OF BURLEY VARIETIES

The varieties of Burley tested may be divided into three classes depending upon the breadth of leaf and character of growth; namely, broadleaf, standup, and broadleaf-standup types. The broadleaf types produce rather coarse, large, broad leaves with a decidedly drooping habit of growth. The standup types

Fig. 11.—STATION STANDUP BURLEY

A field of Station Standup Burley grown at Harrow in 1925. This is recommended as an excellent variety for the Ontario Burley district.

produce narrower and slightly shorter leaves than the broadleaf types with a fairly erect habit of growth. The broadleaf-standup types are usually intermediate between the broadleaf and the standup types in the shape and size of the leaves and in habit of growth. As a rule, the standup varieties mature earlier, cure much brighter and give a smoother leaf of a finer quality than do the varieties of the other two types. The varieties of the broadleaf-standup types have a tendency to vary in colour and quality according to the nature of the season; in seasons of plentiful moisture they grow almost as coarse, cure almost as dark and mature about the same time as the broadleaf types, while in drier seasons they resemble the standup types more closely.

Broadleaf varieties tested included Halleys Resistant and Broadleaf Burley.

Standup varieties tested included Stoner, Judy's Pride, Station Standup, Resistant Standup and Red Burley and seven selections from the Kentucky Experimental Station which were supposed to be resistant to the root-rot but which showed no resistant qualities under Ontario conditions.

Broadleaf-Standup varieties tested included Kelley's, Hopes Standup, Metzgar, Yellow, Hullett's, Recessive and Broadleaf-Standup Burley.

Ten years' results have proven the Station Standup Burley to be the best of these varieties from the standpoint of quality, and when planted slightly closer than the broadleaf varieties, to be practically equal as a yielder to any variety tested.

From past results it is recommended that for both yield and quality the Resistant Burley be planted on diseased or doubtful soils; the Broadleaf Burley on soils particularly susceptible to drought; and the Station Standup Burley on all other types of soil.

GREEN RIVER VARIETY TESTS

Yellow Pryor, Greenwood and Little Hill were the Green River varieties tested.

The Yellow Pryor was a little the largest of the three varieties and produced long, broad, fairly smooth, drooping leaves with fairly large midribs and veins and small ruffles. It is a broadleaf type, the coarsest of the three varieties and matured from seven to eleven days later than the Greenwood or Little Hill.

The Greenwood is a standup type and slightly more brittle than either of the other varieties. It produced long, fairly broad, smooth leaves with medium-sized midribs and veins and small ruffles.

The Little Hill had short, broad, nearly oval, corrugated leaves with small ruffles and medium midribs. While it is a standup type it is slightly more drooping than the Greenwood.

In two years out of three the Greenwood has given slightly the largest yield; however, the yield of the three varieties has usually been rather close.

When cured the Greenwood has usually been slightly darker in colour and heavier bodied than either the Yellow Pryor or the Little Hill.

After curing, the Yellow Pryor and Little Hill were quite similar in the colour and the body of the leaves.

Three years' results indicate that the Greenwood is the most suitable variety for Ontario conditions with the Little Hill ranking second, on account of its earliness.

RESISTANT STRAINS OF GREEN RIVER

Three strains of Resistant Pryor were obtained from Prof. Johnson of the University of Wisconsin, who originated them, and tests started on diseased soil in 1925. These strains were numbered 11001, 11008, and 11009. Of these strains 11001 was most resistant and 11008 next best. Of these strains 11008

was the most promising. It is apparently a well-fixed strain with long, broad leaves of good body. Strains 11001 and 11009 were quite similar to 11008 in shape and size of leaf; however, they were not so well fixed and contained quite a number of plants which had narrow strap-shaped leaves and were decidedly off type.

When cured, strain 11008 gave the largest and brightest leaf of the three, and 11001 the shortest and darkest.

Non-resistant varieties grown on the same plot were not worth harvesting.

MARYLAND VARIETY TESTS

With the object of determining the possibility of producing tobacco of the Maryland type both for home consumption and for export, three varieties were tested. These tests were conducted on the Station, in Norfolk county, and on a very light sandy soil in Essex county. The varieties tested were Prince George, Davis and Tyler. The Prince George gave the largest and heaviest yield of the three and is a broadleaf type; while the Davis and Tyler have much narrower leaves. From the standpoint of quality the Prince George was best with the Davis second.

Since the demand in the home market for this type was apparently very small and since the varieties produced leaves with too much body and consequently too high a proportion of dark-coloured leaf for the export market for which the type was intended, the experiments were discontinued after three years' trials.

Fig. 12.—RUSTICA VARIETY TESTS AT HARROW

Several of the strains and varieties of Rustica tested in 1925 are shown. Just to the right of the centre of the picture are two rows of the Bakoum variety, one of the highest-yielding of the Rusticas tested.

RUSTICA VARIETY TESTS

Seven varieties and strains of Nicotiana Rustica, commonly called nicotine tobacco, were tested during one season for yield. All of these strains and varieties have somewhat heart-shaped, very thick, petioled leaves and they vary considerably in size, date of maturity and yield.

The strains and varieties tested and the yields computed on the basis of a single row were as follows:—

TABLE 2—RUSTICA VARIETY TEST

Variety	Date ripe	Yield per acre		Yield per acre
		Stalks	Leaf	Stalks and leaf combined
U. S. D. A. No. 99	Aug. 19	329·4	630·0	959·4
Blue Makhorka	" 19	344·7	704·7	1,049·4
Makhorka Grande 106	" 31	540·0	1,080·0	1,620·0
Makhorka Grande 108	" 31	630·0	1,642·0	2,272·0
Erbasanta	Sept. 4	990·0	1,485·0	2,475·0
Bakoum	" 10	1,395·0	1,935·0	3,330·0
U. S. D. A. Ephrata	" 18	1,665·0	2,565·0	4,230·0

FERTILIZER TESTS ON FLUE-CURED TOBACCO

During the past ten years, from thirteen to nineteen fertilizer plots have been conducted each year with flue-cured tobacco on the Station, and for the past two years these plots have been run in duplicate. These plots were one-twentieth acre in size, were staked off on land as nearly uniform as could be found, and all of them, with the exception of a check plot and one plot on which a ready-mixed commercial fertilizer was used, had home-mixed fertilizers of different formulae drilled into the rows before the tobacco was set out. The rows of the plots were laid off in such a manner that each plot contained the same number of hills of tobacco. The tobacco on these plots was all planted and harvested on the same days and every possible precaution taken to make the fertilizer the only factor affecting the yield. When harvested, the tobacco from each plot was tagged and kept separate until after it had been stripped, graded and weighed.

The object of this work was to determine the best fertilizer formula for producing flue-cured tobacco from the standpoint of both yield and quality; and also to determine the best sources of nitrogen and potash.

The sources of nitrogen tested were sulphate of ammonia alone and sulphate of ammonia combined with one of the following materials: dried blood, tankage, cottonseed meal and nitrate of soda.

The sources of potash tested were sulphate of potash, carbonate of potash and double sulphate of potash and magnesia.

In order to make the results more applicable to the entire flue-cured district, co-operative fertilizer experiments, using some of the same formulæ on soils differing from those of the Station fields, were conducted with several tobacco-growers during the seasons of 1923 and 1924.

No manure was used in conjunction with these fertilizer plots.

DEDUCTIONS

From the results obtained on the Station and from the plots run co-operatively the following deductions were made:—

1. In most cases commercial fertilizers proved highly profitable on flue-cured tobacco. During ten years the net profit for the use of fertilizers, on the Station, ranged from $119.10 to $238.35 per acre or for every dollar spent in fertilizer there was a net return ranging from $3.75 to $9.96.

2. The results indicated that for the general run of soils, in the flue-cured belt, the best formula would carry the plant food equivalent of:—

140 lb. sulphate of ammonia per acre.
600 lb. acid phosphate per acre.
166 lb. sulphate of potash per acre.

3. For the extremely light sands a fertilizer carrying the plant food equivalent of:—

180 lb. sulphate of ammonia per acre.
500 lb. acid phosphate per acre.
200 lb. sulphate of potash per acre.

would probably be slightly more satisfactory.

4. Apparently in very droughty seasons supplying all of the nitrogen from sulphate of ammonia was superior to supplying one-half of it from such organic sources as dried blood, cottonseed meal or tankage. In seasons of more normal rainfall, supplying one-half of the nitrogen from organic sources proved satisfactory and gave a more drillable fertilizer.

5. Apparently dried blood was the best organic source of nitrogen with tankage and cottonseed meal ranking next in the order named.

6. Supplying one-half of the nitrogen from nitrate of soda apparently increased the tendency of the tobacco to ripen with a dark greenish colour which is objectionable.

7. The average of five years' results indicates that carbonate of potash is not altogether as satisfactory as sulphate of potash for flue-cured tobacco.

8. On the whole, home-mixed fertilizers were apparently slightly better and more economical than the ready-mixed fertilizers tested.

9. The results indicate that sulphate of potash is superior to the double sulphate of potash and magnesia for flue-cured tobacco.

FERTILIZER EXPERIMENTS ON BURLEY

During the past ten years from sixteen to twenty-one one-twentieth-acre fertilizer plots have been run each season on Burley. In conducting these experiments the same procedure was followed and the same precautions were taken as in conducting the fertilizer experiments on flue-cured tobacco. The object of the Burley fertilizer experiments was also the same as for the flue-cured trials.

During the past two seasons these fertilizer plots were run in duplicate on the Station.

In order to make the results more applicable to the entire Burley district, co-operative fertilizer experiments, using some of the same formulæ on soils differing from those of the Station, were conducted with growers in Essex, Kent and Elgin counties and on Pelee island.

DEDUCTIONS

From the results obtained on the Station and from the co-operative plots the following deductions were made:—

1. Generally, fertilizer was very profitable on Burley. During ten years the net profit for the use of fertilizer on the Station ranged from $47.33 to $223.35 per acre or a net profit of from $1.26 to $8.56 for every dollars spent in fertilizer.

2. The results indicate that the best formula for the general run of soils would carry the plant food equivalent of:—

400 lb. sulphate of ammonia per acre.
400 lb. acid phosphate per acre.
166 lb. sulphate of potash per acre.

3. Apparently in very dry seasons supplying all of the nitrogen from sulphate of ammonia was superior to supplying a portion of it from such organic sources as dried blood, tankage and cottonseed meal. In seasons of nearly normal rainfall supplying one-half of the nitrogen from organic sources proved satisfactory and gave a more drillable fertilizer.

4. Apparently dried blood was the most satisfactory organic source of nitrogen, with tankage ranking second.

5. Apparently the combination of sulphate of ammonia and nitrate of soda was inferior to sulphate of ammonia alone.

6. Carbonate of potash is apparently equally as good a source of potash for Burley as the sulphate of potash.

7. Generally the home-mixed fertilizer proved somewhat better and more economical than the ready-mixed fertilizers tested.

8. Sulphate of potash was superior to the double sulphate of potash for Burley.

FERTILIZER TESTS ON GREEN RIVER

Fertilizer tests on the Green River type of tobacco have been conducted for the past three years with the object of determining the best formula for that type of tobacco. In conducting these tests the same procedure was followed and the same precautions observed as in conducting similar experiments with flue-cured and Burley tobacco.

Due to seasonal influences and soil variations the results have been quite variable and it is hardly felt that conclusions are justified; however, the results indicate that on fairly fertile soil a fertilizer consisting of the following ingredients should prove satisfactory:

240 to 320 lb. sulphate of ammonia per acre.
400 lb. acid phosphate per acre.
150 to 200 lb. sulphate of potash per acre.

DRILLING VS. BROADCASTING FERTILIZER FOR BURLEY

With the object of determining the best method of applying fertilizer for Burley tobacco, experiments have been conducted on the Station for seven years in which the effect of drilling the fertilizer under the row was compared with the sowing of it broadcast over the field. For the past two years this experiment has also been conducted on Pelee island. In conducting this experiment every possible precaution was taken to make the method of applying the fertilizer the only factor affecting the yield.

DEDUCTIONS

1. In five out of the seven seasons at the Harrow Station drilling the fertilizer under the row has proven much superior to sowing it broadcast. During this period the increase in yield for drilling has ranged from 41 pounds to 449 pounds per acre and the profit has ranged from $6.15 to $197.56 per acre.

2. For two seasons, drilling the fertilizer under the row has proven vastly superior to sowing it broadcast on Pelee island. During that period the increase in yield for drilling has ranged from 174 to 480 pounds per acre and the profit ranged from $34.80 to $129.60 per acre.

3. The effects of drilling the fertilizer in the row are more pronounced in dry seasons than in seasons of plentiful rainfall.

4. In very dry seasons drilling the fertilizer under the row not only gives an appreciable increase in yield but it also hastens the maturity of the crop. In one instance broadcasting the fertilizer retarded maturity about two weeks, and in other instances a less pronounced retarding of maturity was noted.

MANURE TESTS ON BURLEY

In order to determine the most profitable rate of applying manure to Burley, in conjunction with a good fertilizer, experiments have been conducted for five years in which a series of plots were manured at different rates while the quantity and analysis of the fertilizer applied to each plot was the same. The plots were manured at the rates of 10, 12, 14 and 16 tons per acre.

DEDUCTIONS

1. In three years out of five the results have shown that 14 tons per acre is the most profitable rate for applying manure to fairly fertile soil, when used in conjunction with a good fertilizer.

DIRECT VS. INDIRECT APPLICATIONS OF MANURE TO BURLEY

This experiment was conducted with the object of determining the effect on the yield and quality of the tobacco produced when the manure was applied directly to the tobacco and when it was applied to the crop immediately preceding the tobacco.

Three years' results indicate that applying the manure to the crop preceding the Burley does not decrease the yield and does result in the production of a leaf of finer quality and brighter colour.

TESTS OF VARIOUS KINDS OF MANURE

In order to determine the effect of various kinds of manure on the yield and quality of Burley tobacco, fifteen 1/40 acre plots were staked out and manured with hen, horse, cow, hog, and sheep manure in triplicate at the rate of 12 tons per acre. This experiment was begun in 1925, therefore only one year's results are available. These results are given in table 3.

Table 3—YIELD OF BURLEY TOBACCO ON VARIOUS MANURES

Plot No.	Kind of manure used	Yield per acre			
		Block A	Block B	Block C	Average
1	Hen	1,580	1,580	1,720	1,627
2	Hog	1,320	1,460	1,240	1,340
3	Horse	1,280	1,240	1,840	1,453
4	Cow	1,460	1,380	1,340	1,393
5	Sheep	1,080	1,560	2,040	1,560

Since this is the first year this experiment has been conducted, and since considerable soil variation is apparent, conclusions are not yet justified. Little difference could be observed in the quality of the tobacco grown on the different plots. From the average yield of the three plots of each treatment it would appear that hen manure was best, and that the other manures ranked in the order named as follows: sheep, horse, cow, and hog.

LIMING FOR BURLEY

The effect of applications of ground limestone, applied at the rate of 2,000 pounds per acre, on Burley, has been studied for five seasons; and the effect of land-plaster, applied at the same rate, has been studied one season.

DEDUCTIONS

1. In all cases the use of either ground limestone or land-plaster has resulted in the production of a poorer quality of tobacco.

2. In most cases the use of ground limestone resulted in a decreased yield.

3. Apparently Resistant Burley is the only variety of Burley which can be limed with safety.

4. Ground limestone is apparently less injurious than land-plaster for Burley.

5. Since it has been proven that a slightly acid soil is of material assistance in controlling and checking the development and spread of the root-rot disease of tobacco, the use of lime on any except comparatively new soils which are well supplied with humus and which are known to be free from the root-rot disease, is deemed inadvisable.

NEW EXPERIMENTAL WORK

A long-time rotation test including three-, five-, seven- and nine-year rotations was initiated in 1925. The primary object of this experiment is to compare the yield and quality of tobacco grown one year in a short rotation with tobacco grown two and three years in succession in the longer rotations.

A field study of the effects of a number of crops common to Ontario upon the growth of tobacco following them, is also being made, but significant results will not be secured until 1926 and 1927.

PUBLICATIONS ON TOBACCO-GROWING

The following publications of the Department of Agriculture on tobacco-growing may be obtained by writing the Publications Branch, Department of Agriculture, Ottawa:—

Tobacco-culture in Canada	Ex. Cir. 19.
Tobacco-growing in Canada	Bul. 25, S.S., E.F.
Heating appliances for flue-curing tobacco	Pamp. 51, N.S.
Tobacco seed-beds	Bul. 21, S.S., E.F.
Production des plants de tabac	Pamp. 68, N.S. (French only).
White Burley tobacco in Canada	Bul. 66, N.S.

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