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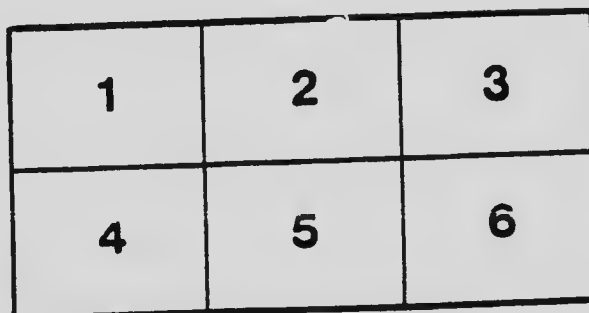
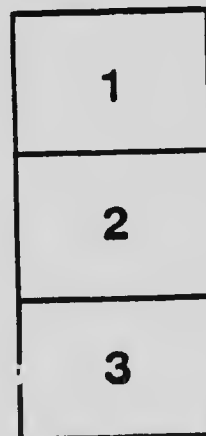
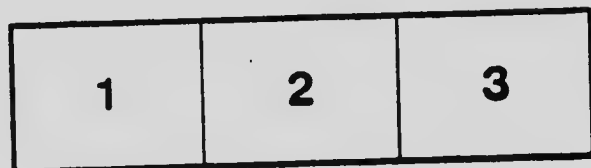
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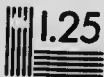
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TOBACCO DIVISION

SUMMARY OF THREE YEARS EXPERIMENTS ON
THE TOBACCO STATION AT HARROW, ONT.

BY

D. D. DIGGES, B.A., M.S.A., Superintendent.

BULLETIN 41—Second Series.

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OTTAWA, June 10, 1919.

The Honourable

The Minister of Agriculture,
Ottawa.

SIR,—I have the honour to transmit herewith the manuscript of Bulletin 41 of the Second Series, entitled "Summary of Three Years' Experiments on the Tobacco Station at Harrow, Ont." and prepared by Mr. D. D. Digges, Superintendent of that Station.

A great deal of very painstaking and accurate work has been done at the Harrow Station during the last few years, the investigations including tests of types of seed bed and manipulation of seedlings, preparation of soil, fertilizing, cultivation and harvesting of the crop, control of insects and diseases, curing, together with testing of varieties and work in plant breeding.

The results of these investigations, as given in this bulletin, should prove interesting and valuable to the tobacco growers of South-western Ontario.

I have the honour to be, sir,

Your obedient servant,

E. S. ARCHIBALD,
Director, Dominion Experimental Farms.

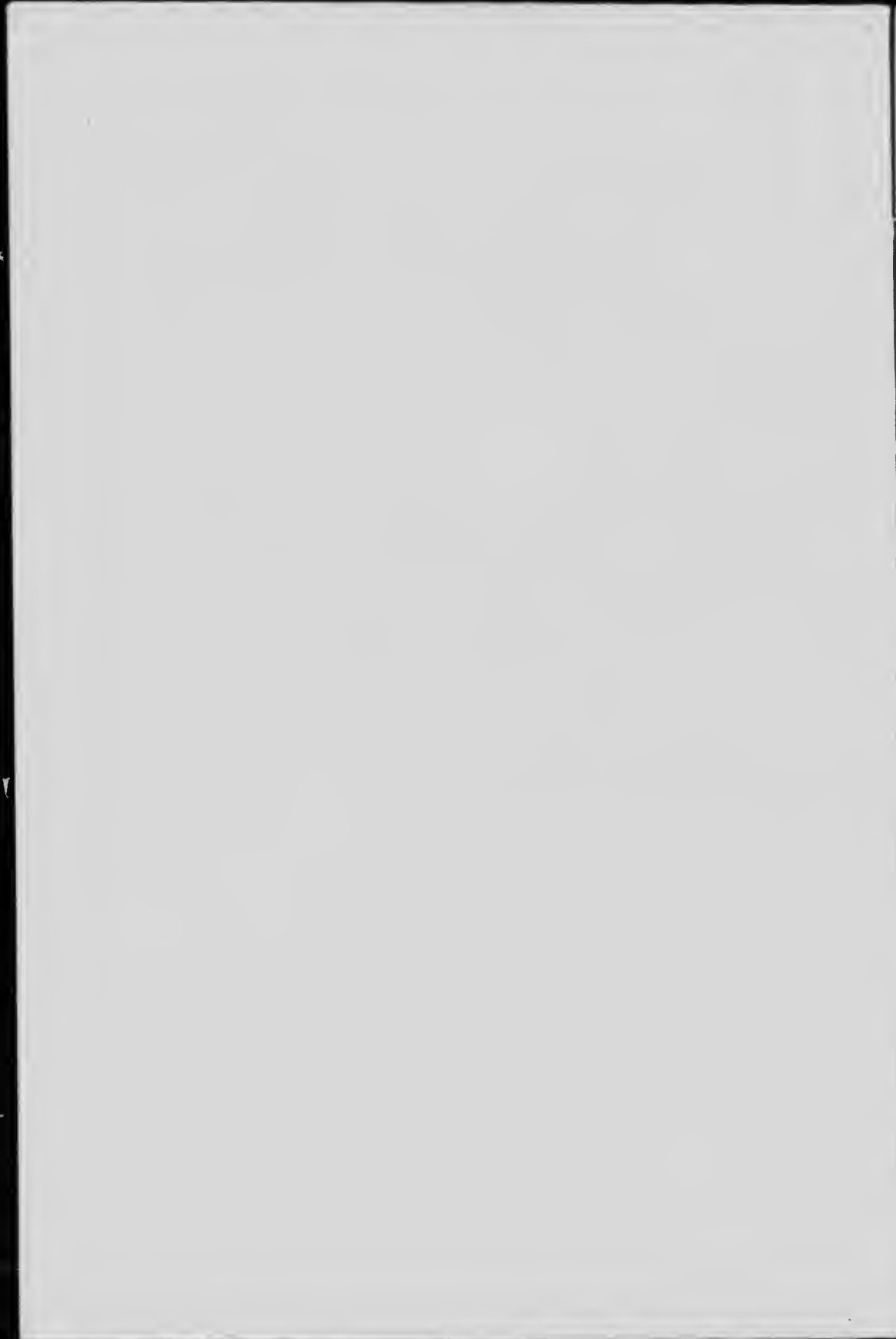


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SUMMARY OF THREE YEARS EXPERIMENTS WITH TOBACCO ON THE TOBACCO STATION AT HARROW, ONT.

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

INTRODUCTION.

The impetus given tobacco growing, in Ontario, during the past three years, due to the increased demand and the good prices paid, has caused quite an expansion in this line of farming. Naturally, many new growers have come into the field and the tendency with all of the growers is to produce as large a crop as possible. However, on account of the shortage of labour the expansion as regards acreage is of necessity limited; and a greater production of tobacco will depend, to a large extent, upon each grower obtaining larger yields from the same acreage than have been produced in the past. Moreover, in order to maintain a steady demand for the home grown raw leaf it would seem advisable for the growers, in general, to improve the quality of their product by using improved methods of culture. With the above facts in mind this paper is being published; and while we realize that the results of experiments which have been conducted for only three years can not be taken too conclusively we feel justified in publishing many of these results because of their close similarity in years differing considerably as to climatic variations.

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, 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.

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 rotten vegetable matter. The compost was hauled the spring before it was to be used and was turned several times during the summer to insure its being well sunned and aired.

Fertilizing.—A portion of each bed was fertilized with sulphate of ammonia at the rate of one ounce per square foot, and the fertilizer was well raked in just before steril-

izing. Other portions of the beds not fertilized before seeding were sprinkled with a solution consisting of two and one-half pounds of nitrate of soda to forty-seven gallons of water, at the rate of one gallon of the solution per eighteen square feet of bed, after the plants were up. A portion of the beds was left unfertilized for comparison.

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

In sterilizing with 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 one hundred pounds pressure, or more, and the steam turned on for thirty minutes. Some sections of the beds were steamed for forty-five minutes and sixty minutes.

The formalin treatment consisted of sprinkling the bed with a solution of one part formalin to fifty parts water, at the rate of one gallon of the solution to two square feet of bed. The solution was put on in two applications twenty-four 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 15, at different rates, with both dry seed and seed which had been sprouted. Both home grown seed and foreign grown tobacco seed was 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 bed with a board and then sprinkling it 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 very 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 beds with their leaves or there will be a tendency for the plants to grow too 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 as the plants increased in size.

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 the bed rot or damping-off fungi 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.

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 up.

Results and Recommendations.—(1) The glass covered beds always produced plants ready for transplanting about two weeks earlier than the canvas covered beds.

(2) The fall steamed cold bed produced plants just as early and equally as thrifty as the spring steamed cold bed; and it is advisable to steam a portion of the beds in the fall as a safeguard against inclement springs.

(3) The glass covered hot bed produced plants about three days earlier than any other type of bed.

(4) The glass covered semi-hot bed produced plants from five to eight days earlier than the glass covered cold bed.

(5) The canvas covered semi-hot bed produced plants about five days earlier than the cold bed similarly covered.

(6) 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 stopped the conduction of the heat from the five top inches of soil to the lower layers of soil; and, as a result, the semi-hot bed not only did not cool off as rapidly as the cold bed but frequently the temperature of the former remained from one to two degrees higher throughout the night than that of the latter.

(7) The use of a compost is recommended as a top dressing for the bed. The compost is usually darker in colour than the soil in the tobacco growing sections, therefore it absorbs more heat and holds the heat longer than the ordinary soils. Then too the rains and watering can not pack it too tightly for the proper development of the plants as is sometimes the case with ordinary soil.

(8) If chemical fertilizers such as sulphate of ammonia are to be applied to the bed before seeding they should be sown on the bed several weeks before it is seeded, in order to allow the soil moisture to dissolve and dilute the fertilizer before it comes into contact with the young plant.

(9) Two or three applications of the nitrate of soda solution proved very beneficial in forcing the plants. However, the solution must not be used too freely or the plants will be forced too rapidly and will be too watery, weak, and spindling to stand the shock of transplanting well. Care must be taken to sprinkle the plants with pure water immediately after using the nitrate of soda solution or it will burn them seriously and may kill them.

(10) In view of the prevalence of tobacco diseases in this district, sterilization of the seed bed is absolutely necessary in order to insure the production of healthy plants.

(11) Sterilization by steaming is superior to the use of chemicals. Steaming not only kills the diseases but the weeds as well and also leaves the soil in an excellent mechanical condition. A bed can usually be steamed for what it would cost to weed it once.

(12) Plants were produced eight days earlier on steamed soil than on soil which had been treated with chemicals; and from eight to eighteen days earlier on steamed soil than on unsteamed soil.

(13) Steaming for thirty minutes at one hundred pounds pressure was apparently sufficient for weed and disease eradication.

(14) Due to the fact that the high temperature to which the soil is raised temporarily in steaming renders conditions somewhat unfavourable for plant growth, it is recommended that the bed be steamed as long as possible before seeding.

(15) The steaming pan should only be deep enough to allow a small space between the top of the soil and the top of the pan for the passage of 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.

(16) Although the sprouted seed developed plants a little earlier than the dry seed very little was gained by using sprouted seed under glass. If the seed is sprouted it should be soaked just long enough for the tiny white gemmule to appear. Sprouting until the leaves develop is a great mistake; many plants are killed in this manner and it is much more difficult to get straight plants.

(17) The rate of seeding must be governed according to the germinative power of the seed. If sown dry, seed which germinates about 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 about April fifteenth. However, if the seed is sprouted, a little more should be used as it is almost impossible not to kill some of them in the sowing operation.

(18) Home grown seed gave plants ready for transplanting from three to seven days earlier than foreign grown seed.

ROTATIONS.

For experimental purposes the land comprising the tobacco station was divided and staked off into forty-one plots on which regular rotations were followed. An accurate record was kept of the yields of all crops grown on these plots, also of all manures and fertilizers applied to them.

Four year rotations of corn, tobacco, cereals, and grass, tobacco, corn, cereals, and grass; three year rotations of tobacco, corn, and cereals; and five year rotations of tobacco, corn, cereals, and grass (two years) in the order named are being experimented with.

Due to the presence in the soil of the fungus *Thielavia basicola* Zopf., which causes the root-rot of tobacco, and the fact that red clover among other legumes is a host plant of this fungus, the growing of clover was entirely abandoned. For hay a mixture of timothy and red top was seeded.

SPRING PREPARATION OF THE SOIL.

All land for the production of tobacco was well broken and pulverized with the disc 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, thus 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. No manure was applied to land to be used for the production of flue cured tobacco.

FALL PLOUGHING vs. SPRING PLOUGHING FOR BURLEY.

Each fall two plots, each containing one and a half acres, were manured for the tobacco crop to be grown on those plots during the following season. Sometime after the first of October 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 disced twice, at different intervals, the last discing constituting the preparation necessary for planting; the sections remaining in sod were ploughed and disced once as a preparation for tobacco. The tobacco on each section of those plots was all fertilized alike, planted on the same day, cultivated alike, harvested on the same day, and every precaution 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 tables:—

Plot No.	Size of Plot.	Treatment.	Yield on Plot, Lbs.	Gain per Acre, Lbs.	Value of Gain per acre.
1	1 acre.....	Fall ploughed.....	1,294½	298	8 cts.
1		Spring ".....	1,071		68 54
2	".....	Fall ".....	1,086	277	63 71
2		Spring ".....	888		
3	".....	Fall ".....	891.5	251	87 85
3		Spring ".....	703		
4	71 acres.....	Fall ".....	620	67.6	23 66
4	74 ".....	Spring ".....	570		

Plots number 1 and 2 were grown in 1917, and plots 3 and 4 in 1918.

Conclusions.—(1) Fall manuring and ploughing for Burley is highly profitable

(2) The profit derived from fall ploughing is even greater than the mere increase in value of the crop obtained, when 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 September the twentieth is an effective means of combatting the cutworm. Very little trouble, due to this pest, being experienced on the fall ploughed sections of the plots.

(3) This experiment was conducted on a sandy loam soil; and while the fall ploughed soil ran together somewhat during the winter the two discings, in the spring, was all that was required to put it in first class condition for planting.

(4) The poor yields on plots number four were due, at least in part, to the fact that these plots were hadly infected with the root rot in certain sections.

FERTILIZER TESTS ON FLUE CURED TOBACCO.

From thirteen to seventeen plots, one-twentieth acre in size, were staked off on land as nearly uniform as could be found. All of these plots, with the exception of one 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 were laid off in such 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, cultivated alike, and cured under as nearly the same conditions as possible. When harvested the tobacco from each plot was tagged and kept separate from that on the other plots until it had been stripped and weighed.

No manure was used to supplement the fertilizer on any of these plots. The data concerning these plots will be found in the following tables:—

Table 1.

Plot No.	Sulphate of Ammonia.	Acid Phosphate.	Sulphate of Potash.	Yield per Acre.	Per cent of Bright Leaf.
	Lbs. per acre.	Lbs. per acre.	Lbs. per acre.	Lbs.	%
1.....	90	.	300	750	8
2.....	120	700	300	810	24.6
3.....	150	700	300	790	17.7
4.....	180	700	300	860	25.9
5.....	180	350	300	710	43.6
6.....	180	466	300	960	34.8
7.....	180	583	300	950	31.5
8.....	180	700	300	900	29.9
9.....	180	700	150	790	20
10.....	180	700	200	790	14
11.....	180	700	250	790	6
12.....	180	700	300	790	26.5
13.....	Fertilizer.....	475	23

Table 2.

Plot No.	Sulphate of Ammonia.	Acid Phosphate.	Sulphate of Potash.	Yield per Acre.	Per cent of Bright Leaf.
	Lbs. per acre.	Lbs. per acre.	Lbs. per acre.	Lbs.	%
1	150	600	200	695	52.6
2	180	600	200	816	60.7
3	210	600	200	965	67.8
4	240	600	200	625	41.6
5	180	300	200	597	54.4
6	180	400	200	602	55.6
7	180	500	200	745	67.7
8	180	600	200	735	67.3
9	180	600	100	926	74.5
10	180	600	150	701	72
11	180	600	200	660	64.4
12	180	600	250	910	67
13	1,000 lbs. ready mixed	No fertilizer.	2-7-3	520	80
14				484	82.6
15	180	600	670 lbs. tobacco stem ashes.	730	67.1

Plots 1, 3 and 4 were badly damaged by excessive moisture so the results obtained on them cannot be considered.

Table 3.

Plot No.	Sulphate of Ammonia.	Acid Phosphate.	Sulphate of Potash.	Yield per Acre.	Per Cent of Bright Leaf.
	Lbs. per acre.	Lbs. per acre.	Lbs. per acre.	Lbs.	
1	100	600	200	530	88.6
2	140	600	200	590	85.5
3	180	600	200	550	84.2
4	210	600	200	550	75.9
5	140	300	200	650	81.5
6	140	400	200	600	81.6
7	140	500	200	760	86.8
8	140	600	200	590	88.1
9	140	600	100	500	79
10	140	600	133	510	79.4
11	140	300	166	555	82.8
12	140	0	200	635	92.1
13	83½	38	62½	570	80.7
14	1,000 lbs. ready mixed	2-7-3, per acre.		635	88.1
15	No fertilizer.			465	82.7
16	Sulphate of Ammonia 50 lbs. per acre—				
	Dried blood 85.7 lbs. per acre.			520	81.7
	Acid phosphate 600	"			
	Sulphate of potash 200	"			
17	Sulphate of Ammonia 70 lbs. per acre—				
	Dried blood 120 lbs. per acre.			465	72
	Acid phosphate 600	"			
	Sulphate of potash 200	"			

Plots 16 and 17 have the same plant food content as plots 1 and 2 respectively. Plot 17. was very badly missing.

General Discussion and Recommendations.—Tables 1, 2, and 3 are records of the results of experiments conducted in the years of 1916, 1917, and 1918 respectively; and since there was a great variation in the seasons of those years and the experiments

were conducted on different pieces of land each year variations in the results obtained were expected.

It will be noticed that the first twelve fertilizer plots in the tables may be divided into three groups of four plots each, namely: nitrogen, acid phosphate, and potash plots respectively. In each of these groups two ingredients of the fertilizer were kept constant while the third ingredient was varied.

From the results recorded in Table 1 the best formula, so far as yield is concerned, would apparently be:—

Sulphate of ammonia..	180 pounds per acre.
Acid phosphate..	583 " "
Sulphate of potash..	300 " "

However, from plots 10 and 11 we see that an increase of potash over plot 9 gave no corresponding increase in yield; consequently, it would seem advisable to change the amount of potash to be used in the above formula from 300 pounds to 150 pounds per acre.

On the basis of bright leaf produced the best formula in Table 1 was:—

Sulphate of ammonia..	180 pounds per acre.
Acid phosphate..	350 " "
Sulphate of potash..	300 " "

However, these figures as regards acid phosphate are in direct opposition to the known tendency of acid phosphate to brighten the colour and should not be taken too conclusively.

From the results recorded in Table 2, the best formula for both yield and colour would apparently be:—

Sulphate of ammonia..	180 pounds per acre.
Acid phosphate..	600 " "
Sulphate of potash	100 " "

Computing the difference between the value of the tobacco grown on plots 9 and 14 (Table 2) at thirty-five cents per pound and subtracting the cost of the fertilizer, computed on the basis of \$400 per ton for potash, \$100 per ton for ammonia, and \$22 per ton for acid phosphate, we find we made \$119.10 clear profit per acre for the use of the fertilizer.

By comparing the results obtained on plot 15 with those obtained on plots 2, 8 and 11 (Table 2), all of which had the same fertilizer applied with the exception of plot 15 on which enough tobacco stem ashes were substituted for sulphate of potash to give the equivalent of potash, it would seem that the ashes may safely be used as a substitute for that ingredient.

From the results recorded in Table 3, the best formula for yield would apparently consist of:—

Sulphate of ammonia..	140 pounds per acre.
Acid phosphate..	500 " "
Sulphate of potash..	290 " "

The results reported in Table 3 were obtained during the season of 1918 which was a very dry season and a very poor one for fertilizers to show up to the best advantage. However, by computing the difference between the value of the tobacco grown on plots 7 and 15 at fifty-five cents per pound and subtracting the cost of the fertilizer, computed on the basis of \$400 per ton for potash, \$110 per ton for ammonia, and \$24 per ton for acid phosphate, we find that there was a net profit of \$108.55 per acre for the use of the fertilizer.

In comparing the results obtained on plots 13 and 14 (Table 3), o. between home mixed and ready mixed fertilizer, it would seem that the source of ammonia used by the manufacturer was better adapted to the production of tobacco, in dry seasons, than the source used in the home mixed fertilizer.

From the results obtained on plot 16 as compared to those obtained on plot 1 it would seem that dried blood was a little slow in liberating its nitrogen for the use of the plant. However, in more humid seasons there is a possibility of this defect being remedied.

From the results recorded in the foregoing tables the following general conclusions were deemed justifiable.

- (1) All of the fertilized plots gave better yields than the unfertilized plots.
- (2) On the fertilizer plots which gave the largest yields there was a net profit of from \$2 to \$3.31 for every dollar spent in fertilizer.
- (3) On these soils, which are representative of the heavier types of soil used in the production of flue-cured tobacco, it would seem that a complete fertilizer is required to secure the maximum yield and the best quality.
- (4) These results also indicate that for both yield and quality, on the heavier soils, the following mixture is best:—

Sulphate of ammonia	140 pounds per acre.
Acid phosphate	500 " "
Sulphate of potash	200 " "

This formula gives a total of 840 pounds of fertilizer per acre; however, the plant food contained in that 840 pounds is approximately equivalent to the plant food contained in 1,100 pounds of a ready-mixed fertilizer with an analysis of 3 per cent ammonia, 8 per cent phosphoric acid, and 9 per cent potash.

FERTILIZER TESTS ON BURLEY.

From sixteen to eighteen one-twentieth acre plots were staked off and the same precautions taken and cultural methods used as on the fertilizer plots of flue-cured tobacco.

The fertilizers used and the results obtained will be found in the following tables:—

TABLE I.—CROP 1917.

Plot No.	Sulphate of Ammonia.	Acid Phosphate.	Sulphate of Potash.	Yield per Acre.	Kind of Plot.
	Lbs. per acre	Lbs. Per acre	Lbs. per acre.	Lbs.	
1	240	400	200	1750	Nitrogen Plots.
2	320	400	200	1860	
3	400	400	200	2240	
4	480	400	200	1410	" "
5	400	200	200	1680	
6	400	300	200	1910	
7	400	400	200	1960	Phosphate " ts.
8	400	500	200	1770	
9	400	400	100	1550	Potash Plots.
10	400	400	133	1840	
11	400	400	156	1550	" "
12	400	400	200	1900	
13	1000 lbs. ready mixed 2-7-3 per acre . . .			1580	" "
14	No. fertilizer			1010	
15	400	400	670 lbs. tobacco stem ashes per acre.	1580	

Plots 4, 5, 6, 8 and 9 were slightly damaged by excessive moisture.

Plots 11 and 15 were badly damaged by water.

The fertilizer on these plots was not supplemented with manure.

TABLE 2.—CROP 1918.

Plot No.	Sulphate of Ammonia.	Acid Phosphate.	Sulphate of Potash.	Yield per acre.	Kind of Plot.
	Lbs. per acre.	Lbs. per acre.	Lbs. per acre.	Lbs.	
1	240	400	200	1230	Nitrogen Plots
2	320	400	200	1500	
3	400	400	200	1670	
4	180	400	200	1090	Phosphate Plots.
5	400	200	200	1290	
6	400	300	200	1080	
7	400	400	200	1360	Potash Plots.
8	400	400	200	1450	
9	400	500	400	1230	
10	400	400	433	1290	"
11	400	400	166	1130	
12	400	400	200	1100	
13	833	438	623	980	"
14	1000 lbs. ready mixed	273	per acre	850	
15	No fertilizer	no manure	..	840	
16	No fertilizer	12 tons per acre	..	1040	"
17	240	400	200	1000	
18	320	400	200	1130	

Plots 17 and 18 had 12 tons of manure per acre, each, to supplement the fertilizer.

The fertilizer on the first 15 plots was not supplemented with manure.

From the yields on the plots it will readily be seen that the soil lacked uniformity. This was more largely due to the rolling character of the soil, some plots being slightly higher and suffering more from drought than others, than to differences in fertility.

General discussion and recommendations: from the results shown in Table 1 the best formula would apparently consist of:—

Sulphate of ammonia	400 pounds per acre.
Acid phosphate	400 " "
Sulphate of potash	200 " "

By computing the difference between the value of the tobacco grown on plots 3 and 14 at twenty-three cents per pound and subtracting the cost of the fertilizer, computed on the basis of \$400 per ton for potash, \$100 per ton for ammonia, and \$22 per ton for acid phosphate, we find that there was a net profit of \$218.50 per acre for the use of the fertilizer; or a net profit of \$3.38 for every dollar spent in fertilizer.

In view of the damage done to plot 15 (Table 1) by water no conclusions could be drawn regarding the substitution of tobacco stem ashes for sulphate of potash.

From the results recorded in Table 2 the best formula for Burley would apparently be:—

Sulphate of ammonia	320 pounds per acre
Acid phosphate	500 " "
Sulphate of potash	133 " "

By computing the difference between the value of the tobacco grown on plots 2 and 15 at thirty-five cents per pound and subtracting the cost of the fertilizer, computed on the basis of \$400 per ton for potash, \$110 per ton for ammonia, and \$24 per ton for acid phosphate, we find that there was a net profit of \$168.60 per acre for the use of the fertilizer; or \$2.70 for every dollar spent in fertilizer.

On comparing the results obtained on plots 13 and 14, or between ready-mixed and home-mixed fertilizers, both of which contained the same amounts of plant food we see that there was an appreciable increase in yield on the home-mixed fertilizer plot over the ready-mixed fertilizer plot.

While plots 17 and 18 were fertilized with a mixture having the same plant food content as that applied to plots 1 and 2 respectively, and in addition received a sup-

plementary application of manure at the rate of 12 tons per acre, the yield on the two former plots was not so high as on the latter plots. This was probably due to the fact that plots 17 and 18 were higher and drier than plots 1 and 2 and too unfortunately the manure applied to those plots did not decay quickly enough to exert much influence on the crop.

All of the fertilized plots gave better results than the plots which were not fertilized.

For the general run of manured soils the following formula should prove to be profitable:—

Sulphate of ammonia	400 pounds per acre.
Acid phosphate	400 " "
Sulphate of potash	150 " "

On the soils which had been manured liberally the amount of sulphate of ammonia in the above formula could probably be reduced to 200 pounds per acre with safety; however, it would hardly be advisable to reduce the amounts of potash and phosphate recommended above.

TRANSPLANTING.

The crop was transplanted from May 27 to June 18, practically all of this work being done with the transplanter.

While in ordinary seasons no difference was noted between the yields of the early and the late planted crops it was observed that the crops planted early and harvested early cured up the brightest colour.

On various plots of Burley and flue-cured tobacco different distances for planting were tested. The results indicated that the best distances for transplanting the various types of tobacco were as follows:—

Broadleaf Burley	44 inches by 28 inches.
Standup Burley	42 " 26 "
Flue-cured	36 " 24 "

While the distance recommended for transplanting the flue-cured varieties may be rather close for the lighter soils of the district for the heavy soils, on this Station, it is the best method we have for overcoming the tendency of the tobacco to grow too coarse and heavy and still obtain a maximum yield.

CULTIVATION AND TOPPING.

The first hoeing and cultivation was given the tobacco about eight days after it was set out. After this the tobacco was cultivated frequently enough to keep down the weeds and grass and also keep a dust mulch formed. All cultivation was stopped after the tobacco had been topped. To continue the cultivation after topping has been found to delay the ripening process and is therefore detrimental, as a general thing.

Topping was done from July 19 to August 10, as soon as the majority of the plants had begun to bud out. In some plots it was necessary to repeat this operation due to the lack of uniformity in the budding out of the plants. At each topping after the first the plants were topped about two leaves lower, than the first, in order to cause the crop to ripen more uniformly.

Postponing the topping operation, as is sometimes done, until a large number of the plants have flowered out can not be too strongly condemned. To do so not only causes a loss of plant food but also retards the ripening process.

GROWING TOBACCO SEED.

The quantities of tobacco seed of the different varieties were produced on the Station. In producing these seed large numbers of plants were selected and the seed

be 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 manilla 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 hulled out, cleaned, and stored in a dry place in some container which will exclude 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.

CONTROL OF INSECT ENEMIES

UPPER M.—Four methods for combatting the cut worm were tested on the station, namely: (1) Spraying 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 1½ ounces of dry arsenate of lead per gallon of water. The plants should be sprayed in the afternoon, one or two days before being set out.

(4) Applying a poisoned bran mixture broadcast on the field after transplanting, used in the following proportions:—

Wheat bran.....	50
Paris green.....	1
Molasses.....	1
Water.....	1½

Conclusions.—While this experiment has hardly been run long enough to arrive at any very definite conclusions the results were as follows: (1) All of the methods gave better results than no treatment at all; (2) The poisoned bran mixture gave the poorest results, and if used at all this mixture should be sown broadcast over the field, late in the afternoon, one or two days before transplanting; care being taken to first kill all weeds and grass; (3) Spraying the plants with the arsenate of lead solution before transplanting was apparently the most effective of the treatments.

Tobacco fields, on the station, which were fall ploughed after September 20 suffered practically no injury from the cut worm and fall ploughing is strongly recommended as a control measure.

THE TOBACCO WORM.—The most effective and economical method for combatting the tobacco horn worm was found to be spraying with arsenate of lead. This may be applied either in solution or in the powdered form. Up until the tobacco is about half grown it 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.

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 six pounds of arsenate of lead is required per acre; for smaller tobacco four and one half 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 thirty per cent arsenic oxide of which not more than one per cent is water soluble.

DISEASES OF TOBACCO.

Mosaic Disease.—The Mosaic Disease commonly known as "Calico," "Frenching," and by various other local names was quite prevalent in the tobacco crops some seasons; it being most common in rather wet years or in low wet regions in the fields. It is apparently very infectious and a large number of healthy plants could 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, the disease still being in evidence after curing in the lack of elasticity of the leaf.

In an experiment conducted to determine the power of tobacco seed to transmit the disease to plants produced from that seed the seed of a Mosaic plant was sown and after the plants, from that seed, had developed sufficiently they were transplanted to the field. Apparently those plants 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. Rountt, relative to the infectiousness of the Mosaic Disease all of the infected plants were pulled out of some plots of tobacco early in the season, while in the other plots no infected plants were 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 the disease could be held in check by pulling out the diseased plants early in the season.

The disease is carried over from year to year in infected leaves and stalks and on decaying these disseminate it.

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 infected pulling up the diseased plants as soon as discovered.

The Root Rot.—The tobacco root rot, caused by the fungus *Thielavia basicola* (B & Br.) Zopf, was quite prevalent in the tobacco fields of this section during the past three years. Although all plants set out on the station had good healthy root systems some of the fields were badly infected.

This fungus attacks the entire root system but is generally more in evidence on the young fibrous roots causing them to decay; whereupon these roots 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 plant are infected, the climatic conditions prevailing at the time of transplanting, and the robustness of the plant. Some plants died; however, 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; however, such plants never attained the size which a normal plant did and usually were harvested green of necessity.

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 had the same unthrifty appearance and lack of growth and often the field would have a checkered appearance, there being several small plants followed by large healthy ones. In either case upon carefully pulling up the plant and examining the fine roots it would be seen that the latter turned black and were rotten. After the plant had become infected no amount of cultivation or fertilizing 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 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 while.

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 even the leaves becoming decayed. Infected plants usually bent over, wilted, and died; though some recovered 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 seeding thinly 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 ventilating the bed well, and allowing the bed to dry out for a while. In warm rainy weather it was very difficult to check it and at all times the best method of control was preventative.

HARVESTING.

The crops were harvested from August 20 to September 18.

Practically all of the tobacco was harvested by the split stalk method. This method consisted of distributing the tobacco bolls along every fourth row in the field, before the harvest, then the plant was split from the top to within two inches of the ground, cut off close to the ground and allowed to lie where it fell until it had wilted sufficiently to handle without breaking; after it had wilted it was placed on the lath and hauled to the barn.

Some of the crop was spudded or needled for comparison, and it was found that the tobacco which was spudded required from two to four weeks longer to cure than that the stalks of which were split; and too the leaves on the stalks which were spudded cured up a darker colour than those on the stalks which were split.

It required two hours less labour per acre to harvest by the split stalk method than by the spudding method.

SCAFFOLDING VS DIRECT CURING.

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 that three days was up the tobacco began to take on a weather beaten appearance and reddened up considerably.

The chief value of scaffolding tobacco in the field lies in the fact that it is a great saver of time and 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.

VARIETY TESTS OF FLUE-CURED TOBACCO.

The many varieties grown may be divided into two general classes, based on the shape and size of the leaf, namely: the broadleaf and the narrow-leaf types.

As a rule, the broadleaf types were somewhat later in maturing, darker in colour when cured, and coarser than the narrow-leaf types; and when both types were planted at the same distance the broadleaf types were the heaviest yielders.

The broadleaf varieties grown included the Long Leaf Gooch, Conqueror, Adeock, White Stem Orinoco, Virginia Gold Leaf, Warne, Hester, Hickory Pryor, and Critcher. Of these the Long Leaf Gooch, Conqueror, Adeock, White Stem Orinoco, Virginia Gold Leaf and Hester grew very rank and coarse; and while they were heavy yielders they were too heavy in body to cure satisfactorily. However, on a very light soil these varieties, especially the Hester, Adeock, and Virginia Gold Leaf, would probably yield better than some of the varieties now being grown and also give a product of good quality.

The Warne is about the most satisfactory variety for the general run of soils, giving a very smooth leaf of good body and a good yield; however, it has a tendency to cure up with a dull face and on heavy soils it grows rather rank.

The Hickory Pryor and Critcher are quite similar in their characteristics; both will give a cured leaf of a bright flashy face and are fair yielders, though not so good as yielders as the Warne. Of the two the Hickory Pryor is the best yielder and has the smoother leaf, and on the heavier soils gives the most satisfactory results of any of the broad-leaf varieties.

The narrow-leaf varieties grown included Flannagan and Gopher Skin. The Flannagan has a fairly smooth medium sized leaf of good body and cures up with a bright flashy face. It is a fair yielder and the results of the experiments indicate that, on the heavier types of soil, if it is planted a little closer than is customary in planting the broad-leaf varieties it will yield just as well as the latter and give a brighter coloured leaf of good body.

The Gopher Skin has a smaller and little rougher type of leaf than the Flannagan. It cures up bright and while it is a fair yielder the quality of the leaf is not quite so good as that of the Flannagan.

VARIETY TESTS OF AIR-CURED TOBACCO.

For the general crop of Burley three varieties were grown, namely: Broadleaf, Station Standup, and Johnson's Resistant Burley.

The Station Standup Burley is characterized by a long, fairly narrow, pointed leaf which grows somewhat erect. While it is a little smaller type of plant than the Broad-leaf Burley if it is planted a little closer than the latter the yield obtained will be about the same, and the Standup always surpasses the Broadleaf in the final colour of the cured leaf. The Standup is especially adapted for planting on dark heavy soils and will give a fair colour on such soils when the Broadleaf would be quite dark.

The Broadleaf Burley has rather broad drooping leaves, is a good yielder, matures a little later than the Standup, and on account of its heavier sap content cures up darker than the latter.

The Resistant strains of Burley tested were of the broadleaf-standup type; *i.e.* not so broad and drooping as the Broadleaf nor so narrow and erect as the Standup. These types possessed leaves of fair breadth, were apparently as good a type as could be wished for in the field, cured up exceptionally bright, but unfortunately the cured leaf is very thin giving, as a result, a comparatively low yield. The Resistant types were a little quicker in starting off to grow after transplanting than the other types of Burley and from the results obtained with them on soil supposed to be diseased or "Burleyed Out" they gave every indication of being resistant to the root-rot. However, due to their rather light yielding character it is advisable to plant them only on diseased land. On such soil they will give better yields than the non-resistant types.

Other Burley varieties grown were as follows:—

Broadleaf Standup Burley.
 Hope's Standup Burley.
 Halley's Burley.
 Hullett's Burley.
 Kelley's Burley.
 Yellow Burley.
 Red Burley.

Of the above varieties the Halley's and Hope's Standup cured up the brightest, the colour being about the same as that of the Resistant and Station Standup Burley. The other varieties cured up about the same colour as the Broadleaf.

Of the above varieties the Hope's Standup was the only one equal to or excelling the Broadleaf and Station Standup as a yielder.

In addition to the Burley varieties strains of Canadian Gold Leaf, Golden Seal, and Fenille D'Or were grown. Of the three the Gold Leaf was the most promising type. It had large, oval, drooping leaves closely placed on the stalk; and, though it was somewhat late in maturing, when planted and harvested early it cured up fairly bright and yielded from 1,800 to 2,000 pounds per acre.

The Golden Seal did not compare favourably with the Gold Leaf. It had more erect, tapering, and narrower leaves than the latter, did not yield as well, but was slightly earlier in maturing.

The Fenille D'Or was the lightest yielder of the three. The leaves of that variety were very thick, narrow, and strap-like. It was fairly early in maturing but cured up a dark colour.

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 and two varieties of fine-cured tobacco (Warre and Flannagan) with the object of determining what difference there would be between the development and maturing of plants produced from unacclimated seed and from seed which had become acclimatized. It was found that plants produced from home grown seed were ready for transplanting from three to six days earlier, ready for topping from three to eight days earlier, and ripe from three to ten days sooner than those produced from unacclimated seed.

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

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 a 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 pliant 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.

