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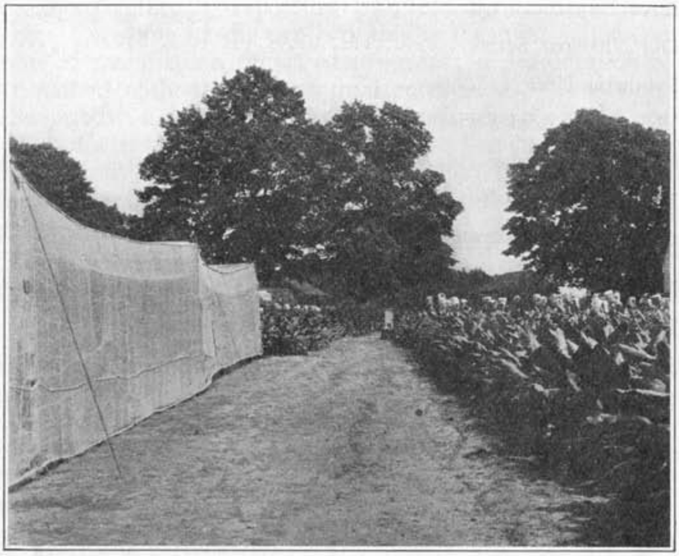

LOOKING SOUTH BETWEEN SHADE AND HAVANA BREEDING PLOTS.

REPORT OF TOBACCO STATION AT WINDSOR

1926

CONTENTS

Report of Tobacco Station—1926

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This report represents a continuation of the policy established last year of annually reporting progress in research work on tobacco. On some of the projects this is the final statement, but on most of them it is a report of progress; a presentation of the data obtained without drawing final conclusions. It is our purpose to publish a separate bulletin on each phase of the work as soon as sufficient new information on that line has been accumulated to warrant it. In accord with this policy three bulletins from the tobacco station are now in press as follows:

"Phosphorus Requirements of Old Tobacco Soils"
"Chemical Preservation of Tobacco Shade Tent Poles"
"Influence of Height and Stage of Topping on the Quality and Yield of Cigar Leaf Tobacco"

These lines of work are not discussed in this report. Limitation of space also makes it advisable to postpone discussion on some of the other projects listed below, in order to cover more fully those which are complete or well along.

The projects which have been actively carried forward in 1926 are as follows:

1. Fertilizer experiments.
   - *The old nitrogen series.* Fifth year. Final report and summary in this bulletin.
   - *Synthetic urea* as a sourse of nitrogen. Second year. All experiments to date described here.
   - *The phosphoric acid series.* Fifth year. Fully treated in Tobacco Bulletin No. 7.
   - *The old potash series.* Fourth year. Fully discussed to date below.
   - *Muriate of potash.* Discussed in full here.
   - *Carbonate and nitrate of potash.* Data on current year presented.
   - *Sulfur, magnesia, chlorine series.* (In coöperation with U. S. Dept. of Agriculture.)
   - *Fractional application series.* Not discussed at this time.
   - *Manure series.* Not discussed.
2. Strain tests.
   - *Havana seed strains.* Third year. Fully discussed below.
   - *Broadleaf strains.* Third year. Discussed below.

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3. IMPROVEMENT OF SHADE TOBACCO BY BREEDING AND SELECTION. No report.
4. COVER CROPS FOR TOBACCO. Report later.
5. BROWN ROOTROT EXPERIMENTS. Second year. Not reported
6. RELATION OF SOIL REACTION TO BLACK ROOTROT AND OPTIMUM GROWTH OF TOBACCO. Discussed briefly below.
9. TESTS OF CHEMICALLY TREATED SHADE CLOTH. Discussed fully here.
10. THE ROLE OF HUMIDITY AND TEMPERATURE IN CURING. Not discussed.
12. TOPPING AND SUCKERING EXPERIMENTS. Published in separate bulletin.
14. CONTROL OF WIREWORM. Progress report below.
15. MISCELLANEOUS TOBACCO DISEASES. Notes below.

FERTILIZER EXPERIMENTS

THE OLD NITROGEN SERIES

This series has now been continued for five years. All fertilizer treatments in 1926 were the same as for the 1925 crop except that the precipitated bone was omitted because this field has shown no need of phosphoric acid.[1] The twenty-one plots, each of one fortieth acre, are on Field 1 of the station farm which is a sandy loam of the Merrimac series and has always grown good tobacco. The field is fairly uniform but a survey by the Soils Department showed some inequalities. In order to overcome any differences in productiveness due to these irregularities, the triplicate groups of seven plots each were located on different parts of the field.

The objects of this series were to compare the yield and quality of Havana Seed Tobacco when:

1. One-fifth of the nitrogen is supplied in mineral carriers.
2. One-half the nitrogen in mineral carriers.
3. None of the nitrogen in mineral carriers.
4. One-half the nitrogen in dry round fish.
5. One-half the nitrogen in high grade tankage.

The other carriers of nitrogen are cotton seed meal and castor pomace, which are considered standard.

In 1926 the fertilizer was applied to all on May 22d and the plants set on June 4th. All were harvested on August 16th. No signficant differences in growth were noticed throughout the season. The early part of the growing season was dry and cold but the growth was fairly satisfactory. Long continued rainy periods during the harvesting and curing season, however, resulted in a rather poor cure with some pole-sweat. All the tobacco from these plots was sorted by experienced sorters in the station warehouse. The yield per acre, variation, percentages of grades and the grade index* for the various plots are presented in Table 1.

[1] See Tobacco Bulletins 5 and 6 for a more detailed description of this series and reports of results of the first four years.

(L) Light wrappers	1.00	(LD) Long darks (19" up)	.30
(M) Medium wrappers ..	.60	(DS) Dark stemming (17")	.20
(LS) Long sec. (19" up)	.60	(F) Fillers	.10
(SS) Short sec. (15 & 17")	.30	(Br) Brokes	.10

The grade index of any plot is obtained by multiplying the percentage of each grade by the price in above schedule and adding the products.

TABLE 1. OLD NITROGEN SERIES, 1926. ACRE YIELDS AND PERCENTAGE OF GRADES.

Plot No.	Nitrogen treatment	Acre yield	% variation†	Percentage of grades: L	M	LS	SS	LD	DS	Fil	Br	Grade index
N1	⅕ N in nitr. soda	1760	0	12	6	26	4	40	1	10	1	.457
N2	½ N in nitr. soda	1730	—2	11	9	32	4	34	1	8	1	.481
N3	⅕ N in sulf. am.	1668	+1	9	12	31	1	38	0	7	2	.474
N4	½ N in sulf. am.	1715	—3	10	12	23	1	42	1	9	2	.452
N5	All N in organics	1743	—1	13	11	22	2	42	0	9	1	.470
N6	½ N in fish	1827	+4	7	9	33	2	39	0	9	1	.455
N7	½ N in tankage	1737	—2	13	8	26	2	41	0	9	1	.473
N1*	⅕ N in nitr. soda	1759	—2	18	14	24	3	30	1	9	1	.519
N2*	½ N in nitr. soda	1765	—2	15	12	24	3	36	1	8	1	.494
N3*	⅕ N in sulf. am.	1860	+3	11	9	27	2	41	1	10	1	.468
N4*	½ N in sulf. am.	1762	—2	10	7	24	2	45	1	10	1	.440
N5*	All N in organics	1872	+4	9	5	31	2	43	0	9	1	.451
N6*	½ N in fish	1825	+2	10	5	30	1	44	0	9	1	.455
N7*	½ N in tankage	1744	—3	15	6	29	1	38	1	9	1	.489
N1**	⅕ N in nitr. soda	1932	—1	25	16	14	5	31	1	7	1	.548
N2**	½ N in nitr. soda	1889	—3	25	17	13	4	31	1	8	1	.546
N3**	⅕ N in sulf. am.	1940	0	23	9	20	3	33	2	9	1	.526
N4**	½ N in sulf. am.	1973	+1	17	8	20	3	43	0	8	1	.485
N5**	All N in organics	1961	+1	15	9	21	2	43	0	9	1	.475
N6**	½ N in fish	1994	+2	23	12	14	3	40	0	7	1	.523
N7**	½ N in tankage	1941	0	31	16	14	4	27	0	7	1	.591

* First replication.
** Second replication.
† Percentage of variation from the average of the group of seven in which it lies.

Since this series of plots has now been continued for five years and will be discontinued in 1927, the results obtained can now be

* *The grade Index.* In comparing the quality of tobacco grown on different plots it is very difficult to keep in mind the percentage of six to eight commercial grades of tobacco from one plot and compare with a like number from another. To simplify these comparisons a grade index was devised. The grade index is a single number expressing the quality of *all* the tobacco grown on a particular plot. It is based on the percentage of carefully assorted commercial grades and the relative price value of the different grades. Although market prices vary from year to year, it was found, after consultation with experienced dealers, that the ratios of prices between the different grades are fairly constant. These adopted price relationships for the different grades are as follows:

summarized. In Table 2 the acre yields of all plots for the five years are recorded and summarized. Since there were some changes in the treatment beginning with 1925 (explained in Bul. 6, p. 6) the results for the first three years are averaged, then those of the last two and finally those for all five years (except for N3, N4 and N5 on which the change in treatment was so great as to make the results not comparable during the two periods). The grade indices for 1925 and 1926 are compared in Table 3. Indices for the first three years are not included because the sorting data were not recorded in a form suitable for computing indices on the same basis as for the other years.

TABLE 2. NITROGEN PLOTS. ACRE YIELDS, IN POUNDS, FOR FIVE YEARS

Plot No.	Nitrogen treatment	Acre yield 1922	1923	1924	1925	1926	Five year ave.	2 yr. 1925-1926	3 yr. 1922-1924
N1	1/5 N in nitr. soda	1396	1768	1307	1814	1760	1609	1787	1490
N2	1/2 N in nitr. soda	1204	1795	1360	1729	1730	1564	1730	1453
N3	1/5 N in sulf. am.	1456	1857	1387	1681	1668	....	1674	1633
N4	1/2 N in sulf. am.	1360	1789	1333	1747	1715	....	1731	1494
N5	All N in organics	1460	1955	1280	1709	1743	....	1726	1565
N6	1/2 N in fish	1382	1927	1440	1993	1827	1714	1910	1583
N7	1/2 N in tankage	1280	1919	1413	1771	1737	1624	1754	1537
N1*	1/5 N in nitr. soda	1396	1768	1387	1787	1759	1619	1773	1517
N2*	1/2 N in nitr. soda	1204	1795	1307	1844	1765	1583	1804	1435
N3*	1/5 N in sulf. am.	1456	1857	1440	1975	1860	....	1917	1584
N4*	1/2 N in sulf. am.	1360	1789	1440	1945	1762	....	1854	1529
N5*	All N in organics	1460	1955	1360	1863	1872	....	1868	1592
N6*	1/2 N in fish	1382	1927	1413	1826	1825	1675	1825	1574
N7*	1/2 N in tankage	1280	1919	1440	1879	1744	1652	1811	1549
N1**	1/5 N in nitr. soda	1396	1768	1493	1914	1932	1701	1923	1556
N2**	1/2 N in nitr. soda	1204	1795	1387	1851	1889	1625	1870	1462
N3**	1/5 N in sulf. am.	1456	1857	1387	1778	1940	....	1859	1567
N4**	1/2 N in sulf. am.	1360	1789	1467	2047	1973	....	2010	1539
N5**	All N in organics	1460	1955	1360	1884	1961	....	1922	1592
N6**	1/2 N in fish	1382	1927	1360	1857	1994	1704	1925	1556
N7**	1/2 N in tankage	1280	1919	1440	1888	1941	1694	1915	1546

SUMMARY OF TABLE 2. AVERAGE OF ALL PLOTS TREATED ALIKE.

Plot No.	Nitrogen treatment	Five years	Two years 1925-1926	Three years 1922-1924
N1	1/5 N in nitr. soda	1643	1828	1521
N2	1/2 N in nitr. soda	1591	1801	1450
N3	1/5 N in sulf. am.	....	1817	1576
N4	1/2 N in sulf. am.	....	1865	1521
N5	All N in organics	....	1839	1583
N6	1/2 N in fish	1698	1887	1571
N7	1/2 N in tankage	1657	1827	1544

TABLE 3. NITROGEN TREATMENT. GRADE INDEX FOR 1925-1926.

Plot No.	Nitrogen treatment	Grade index 1925	1926	Ave.	Ave. of 6 rep.
N1	1/5 N in nitr. soda	.427	.457	.442	.468
N2	1/2 N in nitr. soda	.420	.481	.450	.468
N3	1/5 N in sulf. am.	.431	.474	.452	.459
N4	1/2 N in sulf. am.	.422	.452	.437	.428
N5	All N in organics	.399	.470	.434	.426
N6	1/2 N in fish	.399	.455	.427	.448
N7	1/2 N in tankage	.460	.472	.466	.473
N1*	1/5 N in nitr. soda	.439	.519	.479	....
N2*	1/2 N in nitr. soda	.413	.494	.453	....
N3*	1/5 N in sulf. am.	.451	.468	.459	....
N4*	1/2 N in sulf. am.	.381	.440	.411	....
N5*	All N in organics	.373	.451	.411	....
N6*	1/2 N in fish	.397	.455	.426	....
N7*	1/2 N in tankage	.395	.489	.442	....
N1**	1/5 N in nitr. soda	.418	.548	.483	....
N2**	1/2 N in nitr. soda	.459	.546	.502	....
N3**	1/5 N in sulf. am.	.408	.526	.467	....
N4**	1/2 N in sulf. am.	.387	.485	.436	....
N5**	All N in organics	.389	.475	.432	....
N6**	1/2 N in fish	.462	.523	.492	....
N7**	1/2 N in tankage	.431	.591	.511	....

The following summary of results is based on the data accumulated for five years presented in the tables, our own observations, numerous burn tests (to be recorded in a later report) and the judgment of tobacco experts.

Effect of increasing the amount of nitrate of soda (N1 and N2 plots). In the N1 plots, *one-fifth* of the nitrogen is in the mineral carrier nitrate of soda while in the N2 plots *one-half* of the nitrogen is from nitrate of soda. By reducing thus the quantity of the more expensive organic nitrogen carriers and increasing the mineral carriers a saving of approximately $10.00 per acre is effected. What has been the effect on the quality and on the yield? Since during the first three years one-half of the mineral nitrogen was from sulfate of ammonia, we should probably compare only the figures for 1925 and 1926. During these years the N1 plots produced an average of 27 lbs. per acre more than the N2 plots. The grade index was exactly the same, .468. Multiplied by 27 this gives a difference of $12.64 in favor of the N1 plots which compensates for the $10.00 which was saved on the fertilizer. If we disregard the slight change in formula during the first three years and compare the average yields of 15 replications for each, there is a difference of 52 lbs. in favor of the N1 plots or a difference of 71 annually during the first three years.

Conclusions from the five years' tests. There has been no bad effects on the quality of the tobacco from increasing the nitrate of soda. There has, however, been a slight reduction in yield which approximately compensates for the saving in cost of fertilizer. In case the organic fertilizers become more expensive and the mineral carriers less expensive (a tendency which may be anticipated) there seems to be no good reason why nitrate of soda cannot be used in larger quantities to replace the organics.

Comparison of nitrate of soda with sulfate of ammonia as a source of one-fifth of the nitrogen (N1 and N3 plots). The formula for the N3 plots was the same during the last two years as for the N1 plots except that sulfate of ammonia was used on the N3 plots. The average yield of six replications during these two years was 11 pounds per acre less on the sulfate of ammonia plots than on the nitrate of soda plots. The grade index was also lower, indicating that the quality was not quite as good. Notes taken at the time of sorting and burn tests also confirm the latter statement. The high percentage of sulfur in sulfate of ammonia makes it a less desirable source of nitrogen than nitrate of soda.

Conclusion. Nitrate of soda seems preferable to sulfate of ammonia to supply one-fifth of the nitrogen in the fertilizer formula.

Comparison of nitrate of soda with sulfate of ammonia as a source of one-half of the nitrogen (N2 and N4). This comparison was made only during 1925 and 1926. Averages of six replications of each during those two years show a gain in yield of 64 pounds by the use of sulfate of ammonia. It will be noticed, however, that the grade index for the sulfate of ammonia was the next lowest of all the plots. During both years the percentage of dark leaves was higher on these plots than for any other treatment. The quality at time of sorting was rated as low as any. There was considerable white and prominent vein. When burn tests were made, these plots rated the lowest of any in fire-holding capacity and color of ash.

Conclusions. Sulfate of ammonia keeps up the yield but produces tobacco of poor quality and poor burn.

All nitrogen from organic carriers compared with one-fifth of the nitrogen from mineral sources (N1 and N5 plots). The average yield of the six tests of each was nearly the same but the average grade index was lower for the organic plots. The tobacco on the latter plots was better during the second than during the first year.

Conclusions. Although the data are not entirely convincing we may at least conclude that no harm has come from supplying one-fifth of the nitrogen from nitrate of soda and there has certainly been no advantage in supplying it all from organic carriers.

One-half of the nitrogen from dry ground fish (N1 and N6 plots). Except for a small reduction in total quantity of fertilizer at the beginning of the fourth year (Bul. 6, p. 6) the treatment of these plots has remained the same throughout the five years of the experiment. We therefore have 15 replications of each. The average yield of these fifteen replications has been 55 pounds

higher for fish plots. In fact the yield was the highest of any in the nitrogen series. The average grade index, however, has been somewhat higher for the plots in which there was no fish.

Conclusions. The fire-holding capacity was considerably lower in the fish plots. Apparently excessive use of fish has impaired the fire-holding capacity. Also the ash was not as white on the fish plots.

One-half the nitrogen from high grade tankage (N1 and N7 plots). The treatment of these plots also has remained practically unchanged during the five years. The average yield for the fifteen replications has been 14 pounds per acre higher for the tankage plots than for the N1 plots. The grade index is also slightly higher on the tankage plots. In the burn tests, the fire-holding capacity has been practically as good as for the N1 plots. The ash color has not been quite as good as for the N1 plots. No difference in aroma or other burn characters were observed.

Conclusions. In every other respect except a somewhat darker ash, the tobacco from the tankage plots has been just as good as, if not a little superior to, that from the N1 plots throughout the five years. Although we would not advocate the use of tankage as the only source of nitrogen, the very favorable results certainly indicate that it could be used more extensively to replace cottonseed meal than it has been, especially during years when cottonseed is high. The principal advantage in using tankage is its relatively low cost. The following information concerning tankage has been furnished by Dr. E. M. Bailey of the Chemistry Department:

For the last five years, the average price for nitrogen in tankage has been 26¢ per pound. During the same period the price for nitrogen in cottonseed meal has been 34½¢ per pound. Tankage comes from meat and bone refuse from slaughter houses and the nitrogen and phosphorus content varies according to the amount of bone included (bone raising the percentage of phosphorus). Low grade tankage contains less than 5% nitrogen and over 15% of phosphoric acid. High grade contains more than 5% nitrogen. Average analyses of the two for the five years shows the percentage of nitrogen in cottonseed meal and tankage to be about the same. Other ingredients found in tankage according to analyses made for the tobacco station are 5.1% calcium oxide, 0.29% magnesium oxide, 2.6% sulfate and 0.31% chlorine.

SYNTHETIC UREA AS A SOURCE OF NITROGEN

Synthetic urea and other forms of air nitrogen compounds give promise of becoming the cheapest and most plentiful source of fertilizer nitrogen. If they can be used to advantage they are certainly the most economical carriers of nitrogen on the market. Tests were started in 1925 on six one-fiftieth acre plots on Field IX of the Tobacco Station farm. The plan of the experiment was to compare the yield and quality of Havana seed tobacco when the nitrogen of the fertilizer mixture was:

1. All from urea.
2. One-half from urea (other half from cottonseed meal and castor pomace).
3. None from urea (standard formula).

The composition of the fertilizer mixtures is given below:

Plot N1. Standard formula. No urea.

Carrier name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	1,463.4	$36.59	120	42.4	21.9	10.2
Castor pomace	588.2	8.82	40	10.6	5.9	4.7
Nitrate of soda	212.7	7.23	40	....	....	....
Precipitated bone	277.9	8.34	....	107.0	....	....
Sulfate of potash	172.2	4.74	....	....	86.1	....
Carbonate of potash	132.2	9.94	....	....	86.1	....
Total	2,846.9	$75.66	200	160.0	200.0	14.9

Plot N8. 1/2 ammonia in synthetic urea.

Carrier name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Cottonseed meal	914.6	$22.87	75	26.5	13.7	6.4
Castor pomace	367.7	5.52	25	6.6	3.7	2.9
Urea	178.4	13.38	100	....	....	....
Precipitated bone	329.6	9.89	....	126.9	....	....
Sulfate of potash	172.0	4.73	....	....	86.0	....
Carbonate of potash	132.3	9.92	....	....	86.0	....
Double sulfate	40.7	.71	....	....	10.6	4.6
Total	2,135.3	$67.02	200	160.0	200.0	14.9

Plot N9. All ammonia in synthetic urea.

Carrier name	Lbs. per acre	Cost an acre	Lbs. plant nutrient per acre NH_3	P_2O_5	K_2O	MgO
Urea	357.0	$26.78	200	....	....	....
Precipitated bone	415.5	12.47	....	160.0	....	....
Sulfate of potash	165.8	4.60	....	....	82.0	....
Carbonate of potash	127.4	9.55	....	....	82.8	....
Double sulfate	131.8	2.31	....	....	34.3	14.9
Total	1,197.5	$55.70	200	160.0	200.0	14.9

Thus by using the N8 formula the cost of the fertilizer would be reduced $8.64, while by using the N9 formula it would be reduced $19.96 per acre.

The fertilizer was applied May 26 and the plants set June 14, 1926. All plots were identical as to location and treatment in 1925 and 1926. The growth of the tobacco was not uniform but the poor spots showed no relation to the fertilizer treatment since no consistent differences in growth as between the plots were

observed during the season. All the tobacco was harvested on August 19, and when cured was sorted in the station warehouse. The cure was good with only a trace of pole sweat.

TABLE 4. UREA PLOTS. SORTING RECORD FOR 1926.

Plot No.	Source of nitrogen	Percentage of grade: LW	MW	LS	SS	LD	DS	Fil	Br	Grade index
N1*****	Standard	24	7	10	9	35	1	12	2	.492
N1******	No urea	22	6	10	8	39	1	12	2	.473
N8	½ nitrogen	30	12	7	9	31	0	10	1	.545
N8*	from urea	9	5	20	9	40	1	12	4	.405
N9	All nitrogen	22	11	9	9	36	1	10	2	.489
N9*	from urea	17	5	14	7	41	1	12	3	.445

The sorting records are presented in Table 4. The yields per acre and grade indices are summarized for both 1925 and 1926 in Table 5. The quailty of the tobacco from all these plots in 1926 was rated as excellent at the time of sorting except that the veins were somewhat more prominent on the N9* plot.

TABLE 5. SYNTHETIC UREA PLOTS. ACRE YIELDS AND GRADE INDICES FOR 1925 AND 1926.

Plot No.	Nitrogen treatment	Acre yield 1925	Acre yield 1926	Ave. of 4 replications	Grade index 1925	Grade index 1926	Ave. of 4 replications
N1*****	Standard, no urea	1364	1501	1534	.268	.492	.411
N1******	" " "	1561	1711		.411	.473	
N8	½ urea	1356	1488	1544	.325	.545	.395
N8*	" "	1597	1695		.303	.405	
N9	All urea	1347	1622	1561	.257	.489	.386
N9*	" "	1465	1810		.352	.445	

Comparing the averages of the four replications as presented in Table 5, it appears that the difference in yield as between the three (less than 2%) is too small to be significant. The grade index is slightly in favor of the standard formula but here again the difference is pretty small.

Although it would probably be unwise at present to derive all the nitrogen of the fertilizer formula from urea, there is no indication of harm from using it to furnish a part of the nitrogen.

PHOSPHORIC ACID SERIES

Results of the tests of 1926 and a review of the five-year test are published as a separate bulletin, **Phosphorus Requirements of Old Tobacco Soils,** Tobacco Bulletin 7 of this station. It was found that this soil, like many other tobacco soils, has such an accumulation of phosphorus that it gives no response whatever to phosphoric acid applications.

THE OLD POTASH SERIES

The purpose of this experiment was to compare sulfate of potash-magnesia (double manure salts) with high grade sulfate of potash as a source of potash (see Tobacco Station Bul. 5, p. 24, and Bul. 6, p. 22, for more detailed description of the experiment and composition of the fertilizer mixtures). The six plots of one-fortieth acre each are located on Field I on the Tobacco Station farm. The fertilizer mixture is a standard formula and the same for all plots except for the source of potash. For the K1 plots all potash was in sulfate of potash, for the K2 plots it was in double sulfate of potash-magnesia, and for the K3 plots it was derived equally from each of these carriers. No change was made in the formula for 1926 except for the omission of precipitated bone. Fertilizer was applied on May 22d and the plants set on June 4th. No difference in growth were apparent throughout the season. There was no indication of magnesia starvation. On account of unfavorable curing season, some of the plots had considerable pole sweat and although the brokes were sorted, the data on these plots are not as reliable as for the previous year. The yields and sorting records are presented in Table 6.

TABLE 6. OLD POTASH SERIES. YIELD AND SORTING RECORD FOR 1926.

Plot No.	Source of Potash	Acre yield	Percentage of grade LW	MW	LS	SS	LD	DS	Fil	Br	Grade index
K1	High grade	1739	11	7	31	1	40	0	9	1	.471
K1*	sulfate	1832	18	10	23	2	37	0	9	1	.505
K2	Sulf. of	1831	13	7	30	2	36	1	10	1	.479
K2*	pot.-mag.	1833	16	7	29	2	36	0	9	1	.500
K3	Half from	1712	12	6	31	2	39	0	9	1	.475
K3*	each	1648	11	6	30	2	39	0	11	1	.461

The yields and the grade indices for the four years of this experiment are summarized in Tables 7 and 8. Every treatment has now been replicated eight times. The difference between the average yields are approximately 2% while the average grade indices show a difference of only 1% for the four years.

TABLE 7. OLD POTASH SERIES. ACRE YIELDS FOR FOUR YEARS.

Plot No.	Form of potash	Acre yields by years 1923	1924	1925	1926	Average	Ave of 8 replications
K1	High grade	2056	1333	2054	1739	1796	1815
K1*	sulfate	2056	1387	2061	1832	1834	
K2	Sulf. of	1966	1413	1932	1831	1786	1781
K2*	pot.-mag.	1966	1413	1892	1833	1776	
K3	Half from	2039	1467	2029	1712	1812	1775
K3*	each	2039	1333	1929	1648?	1738	

TABLE 8. OLD POTASH SERIES. GRADE INDICES FOR TH

Plot No.	Grade index 1924	1925	1926	Average	
K1	.281	.475	.471	.409	.415
K1*	.291	.475	.505	.422	
K2	.281	.476	.479	.412	.414
K2*	.273	.471	.500	.415	
K3	.316	.461	.475	.415	.410
K3*	.270	.483	.461	.405	

Since these differences are quite too small to be significant we may conclude that the yield and quality of the tobacco are not affected by the partial or complete substitution of sulfate of potash-magnesia for high grade sulphate. During these four years there has been no indication of magnesia hunger on any of the plots. Careful observations at the time of sorting and pooling by experts have failed to show any significant differences in quality. Apparently there is magnesia enough (15 lbs.) in the organic part of this fertilizer to satisfy the requirements of the crop. It does not necessarily follow that all tobacco soils will show this same indifference to magnesia. but since very few cases of "sand-drown" have been observed in Connecticut, we are inclined to believe that in general there is no need of using double manure salts wherever the mixture contains considerable organic material. Sulfate of potash-magnesia is a more expensive source of potash than is high grade sulfate and is more bulky. It also contains more sulfuric acid in proportion to the quantity of potash it carries. The sulfur content of the fertilizer mixture should be kept as low as possible.

Thus. unless the grower has had trouble from "sand-drown" on his field. there appears to be no advantage—and there are some disadvantages—in using sulfate of potash magnesia.

MURIATE OF POTASH

Muriate (chloride) of potash has been avoided by tobacco growers because chlorine was thought to injure the fire-holding capacity. Within the last few years, however, there has been a rekindled interest in muriate due to increased American production and to its use on some types of tobacco in the south. Since no field tests in New England are on record, two plots on Field I were treated with a fertilizer mixture exactly like the standard formula used on the N1 and P1 plots except that the potash was supplied in muriate instead of sulfate and carbonate. The plots were set at the same time as the rest of the field and all cultural operations were the same during the two years of the experiment, viz., 1925, 1926.

There were no noticeable differences in growth or other characteristics in the field. When the tobacco from these plots was sorted it seemed heavier and darker and had a greasy feeling when handled. It came "into case" more quickly than the tobacco from the other plots. The sorting records for these along with the N1 and P1** plots, which were adjacent and may be regarded as controls for the K6 plots, are presented in Table 8A.

TABLE 9A. MURIATE OF POTASH AND PLOTS AND ADJACENT CHECKS. 1925-26. YIELD AND SORTING RECORDS.

Plot No.	Carrier of plot	Year	Percentage of grades L	M	LS	SS	LD	DS	Fil	Br	Grade index	Average	Acre yield	Average
K6	muriate	1925	3	2	24	5	45	7	3	11	.364	.378	1685	1739
		1926	9	7	23	3	47	0	10	1	.431		1880	
K6*		1925	2	4	20	6	44	12	4	8	.350		1799	
		1926	5	2	25	0	44	0	22	2	.368		1594	
N1	sulfate and carbonate	1925	12	9	19	4	32	7	6	11	.427	.442	1814	1732
		1926	12	6	26	4	40	1	10	1	.457		1760	
P1**		1925	11	11	16	7	26	12	8	9	.412		1717	
		1926	14	6	25	4	42	0	8	1	.473		1636	

According to the data presented in Table 8A, the yield is not affected by the substitution of muriate for a combination of sulfate and carbonate. There has been, however, a material lowering of the grade index; it will be noted that the percentage of dark grades has been increased by muriate.

In order to see what effect the muriate had on the fire-holding capacity, these leaves were tested along with those from plots where other forms of potash had been used. One hundred and sixty tests (electric match method) were made on the tobacco from each plot after fermentation. The results were as follows:

Tobacco fertilized with sulfate of potash burned	34.3 sec.
Tobacco fertilized with carbonate of potash burned	44.9 "
Tobacco fertilized with muriate of potash burned	4.8 "
Tobacco fertilized with 2/3 nitrate, 1/3 carbonate burned ..	43.1 "
Tobacco fertilized with ½ sulfate, ½ carbonate burned ...	38.0 "
Tobacco fertilized with 1/3 carbonate, 1/3 nitrate, 1/3 sulfate	43.5 "

It is thus apparent that muriate has had a very serious effect on the fire-holding capacity. This conclusion is confirmed by tests in other tobacco sections of America and in other countries. An excellent review of this subject has recently been published by Dr. E. H. Jenkins (Conn. Sta. Bul. 282:92-95, 1926) to which the interested reader may refer for more detail.. In the South where muriate is used, it is not so essential that these types of tobacco have good burning qualities. Also they use only small quantities of fertilizer and tobacco is frequently grown in rotation. With our conditions, no grower can afford to apply muriate of potash either on his tobacco or on crops grown where he may wish to grow tobacco later. Some growers, however, have become unnecessarily alarmed because some of the ingredients used in fertilizer mixtures contain small quantities (usually less than 1%) of chlorine. It seems unlikely that such small quantities could have an appreciable effect on the burn.

CARBONATE AND NITRATE OF POTASH

The series of plots in which these two carriers of potash are being compared with sulfate is only in the second year and is planned to run at least five years. The data on the 1926 crop is presented in Table 9. A more complete discussion will be postponed until the experiment has continued longer.

TABLE 9. CARBONATE AND NITRATE OF POTASH PLOTS, 1926. YIELD AND SORTING RECORDS.

Plot No.	Potash carrier	Acre yield	Percentage of grades LW	MW	LS	SS	LD	DS	Fil	Br	Grade index
K4	sulfate	1135	5	4	8	12	34	10	22	5	.307
K4*		1294	8	9	5	12	35	15	16	0	.351
K5	carbonate	1325	6	5	9	14	33	16	16	1	.331
K5*		1312	5	5	14	10	38	7	15	6	.343
K7	⅔ nitr.	1350	6	4	9	15	32	15	16	3	.328
K7*	⅓ carb.	1393	8	7	15	11	36	5	14	4	.381
K8	½ sulfate	1362	7	7	9	15	34	12	14	2	.353
K8*	½ carbonate	1403	6	11	15	13	38	2	12	3	.388
K9	⅓ sulf. ⅓ carb.	1373	7	10	8	13	37	11	13	1	.364
K9*	⅓ nitr.	1424	11	11	14	11	35	2	13	3	.388

The fertilizer was applied on May 25 and the plants set on June 5. The land here (Field V) is light and sandy; hence these plots suffered severely from the dry weather which prevailed during the early growing season and never made a satisfactory growth. All were harvested on August 10.

Thorough examination of the roots after harvesting the crop showed no serious rootrot infection on any of the plots. Occasional lesions could be found on roots from all the plots (a condition common in all old tobacco fields) but these were not more numerous on the carbonate plots than on the others. There were no differences in growth during the summer to indicate rootrot effects. The reaction of the soil on all plots was tested before application of the fertilizer in the spring and at the time of harvesting and the results compared with those taken at this time during the preceding year. During the two years of this experiment there has been no appreciable decrease in acidity on any of these plots.

The relative fire-holding capacity of the tobacco from each of these plots is indicated on p. 38. Some have objected to nitrate of potash because they said the tobacco burned with a crackling or sputtering due to the saltpetre which it was supposed to contain.

When cigars made from the crop of 1925 were smoked, however, they did not sputter or crackle although this fault was carefully watched for. Such a sputtering may frequently be observed in very "grainy" leaves in any crop of tobacco but it does not indicate that nitrate of potash was used in the fertilizer.

Strain Tests

HAVANA STRAINS

The purpose of these tests, which have now been in progress for three years, is to find whether there are in our Havana seed tobacco certain strains which are superior to others, and if so, to pick out the best ones for seed distribution and for selection with the object of further improvement. (The plan of the experiment and progress of the first two years is described in Tobacco Station Bulletin 6, pp. 37-41.) For the tests of 1926, the original eighteen strains were reduced to nine by selecting those which had the best records of performance for the two preceding years. A new strain furnished by Clark Bros. of Windsor was added as well as three rootrot resistant strains, 148C, 142C3, 142A3, and a strain selected by Dr. James Johnson of Wisconsin, called Conn. 38. These were all grown side by side in single row series on three different fields on the station farm and on the farm of Mr. Frank Solkowski of Windsor.

The plants were set on the station farm on June 4 and on the Solkowski farm on June 8. The most striking differences observed throughout the summer were the stronger growth of the resistant strains, and the close setting and greater number of leaves. The Clark strain grew taller than the others and was readily distinguished by a peculiar crinkling of the leaves. The differences between the others were not very evident in the field. Each row on Fields I and III contained 60 plants, on Field II, 30 plans and on the Solkowski field, 120 plants. Due to the fact that some of the short rows on Field II were saved for seed, the data on this field are not complete and in making the averages below (Table 11) they are omitted. The tobacco on the station farm was harvested on August 9 and on the Solkowski farm on August 20. All strains were sorted in the station warehouse. Sorting data and acre yields are presented in Table 10. These data are summarized in Table 11.

Table 10. Acre Yield and Percentage of Grades in Havana Seed Strain Tests of 1926.

Source of Seed	Rep.	Acre yield	Percentage of grades									Grade index
			LW	MW	LS	15″	17″	LD	DS	Fil	Br	
Shean		1599	7	17	14	3	6	36	1	10	6	.409
	*	1475	6	11	17	1	4	36	2	14	9	.378
	**	1513	13	13	18	1	4	34	1	13	3	.451
	***	1894	11	11	17	1	4	39	2	12	3	.431
Crafts		1654	4	16	17	2	7	35	2	12	6	.380
	*	1562	8	14	10	4	5	36	6	12	5	.388
	**	1600	7	9	22	0	4	34	3	16	5	.397
	***	1920	19	12	10	2	4	43	0	9	1	.479
Brown		1747	6	12	20	3	4	34	4	11	6	.400
	*	1489	20	13	13	2	5	30	5	13	5	.495
	**	....	..	..	..	..	..	..	..	..	..	....
	***	1894	21	16	13	1	3	35	1	9	1	.513
Pelissier		1551	5	10	7	4	6	40	9	17	2	.339
	*	1489	8	7	7	2	4	46	5	16	5	.351
	**	1524	7	15	13	1	7	37	3	14	3	.396
	***	1793	20	12	8	2	5	41	2	10	0	.480
Viets		....	..	..	..	..	..	..	..	..	..	....
	*	1445	6	18	12	2	5	33	4	16	4	.388
	**	1475	5	10	11	1	5	43	2	16	7	.350
	***	1829	19	12	9	2	4	42	1	9	2	.473
Duncan		1576	5	12	13	1	5	45	4	12	3	.376
	*	1696	10	12	14	1	4	37	3	16	3	.407
	**	1530	6	10	14	0	5	36	3	16	10†	.359
	***	1937	22	15	11	1	4	35	1	9	2	.509
Henshaw		1316	4	10	15	3	5	36	5	14	8	.354
	*	1460	4	10	22	1	4	41	1	12	5	.409
	**	1536	5	24	13	0	4	28	3	14	9	.427
	***	1879	13	12	22	1	3	37	1	8	3	.470
Peckham		1623	3	17	29	1	4	32	1	15	7	.387
(?)	*	1562	11	20	13	2	4	33	1	10	6	.443
	**	1600	12	24	9	0	4	31	2	12	6	.447
	***	1973	22	20	9	1	3	33	0	9	3	.517
Kendall		1484	4	14	17	4	7	36	4	12	2	.389
	*	1360	6	13	18	1	3	34	4	15	6	.389
	**	1579	16	27	3	2	2	25	2	16	6	.456
	***	1836	23	15	8	0	3	42	0	8	1	.512
Clark		1600	9	15	16	1	3	34	1	13	8	.413
	*	1562	12	12	14	1	5	37	1	13	5	.425
	**	....	..	..	..	..	..	..	..	..	..	....
	***	1915	15	18	10	1	3	42	1	8	2	.468
148 C		1807	9	12	29	1	2	21	1	9	16	.435
	*	1635	12	9	28	1	3	23	1	10	13	.458
	**	1666	10	8	20	0	2	24	3	17	16	.388
	***	2045	18	19	15	2	3	35	0	6	2	.512
142 C3		1791	15	5	22	2	3	34	1	14	4	.449
	*	1679	19	8	17	1	4	30	2	14	5	.470
	**	1666	6	8	17	0	4	30	10	19	6	.357
	***	2174‡	11	11	16	2	4	45	0	6	5	.436
142 A3		1806	8	4	21	1	5	27	0	12	22	.363
	*	....	..	..	..	..	..	..	..	..	..	....
	**	1457	8	11	14	0	6	22	8	22	9	.361
	***	1951	12	13	21	1	4	35	0	9	5	.458
Conn. 38		1697	5	9	20	0	3	28	3	12	20	.358
	*	1577	9	15	18	4	6	30	2	12	4	.430
	**	1600	6	13	16	0	6	25	6	20	8	.367
	***	1850	24	11	13	1	4	32	0	9	6	.510

† Bundle accidentally got wet on one side and high percentage of brokes due to this.

‡ This bundle was overdamp. Probably weight is too high, therefore some deducted in making the average.

TABLE 11. SUMMARY OF TABLE 10. BASED ON 3 REPLICATIONS.

Source of seed	Average yield	Average grade index
Shean	1656	.406
Crafts	1712	.416
Brown	1703	.469
Pelissier	1611	.390
Viets	1637	.403
Duncan	1736	.431
Henshaw	1552	.411
Peckham	1723	.449
Kendall	1560	.430
Clark	1692	.435
148 C	1829	.468
142 C3	1860	.452
142 A3	1878	.407
Conn. 38	1708	.433

As regards yield, it is apparent from these data that the resistant strains uniformly produce more tobacco than our ordinary strains. This same characteristic has been observed in other tests which we have made with these strains in previous years and other unrecorded tests of 1926. Among the other strains, the yield is good and practically equal for the Crafts, Brown, Duncan, Peckham and Conn. 38 strains. The difference between the highest and lowest of these five is less than 2% and could hardly be considered significant.

In respect to grade index, the following strains rank in the order named: Brown, 148C, 142C3, Peckham, Duncan, Kendall, Crafts. Leaving out of consideration the resistant strains (to be discussed below) it is thus seen that the four strains, Brown, Duncan, Crafts and Peckham, are in the first five both as to grade index and yield. When the samples were pooled for quality by the judges, the first six were rated in the following order: Brown, Viets, Crafts, Peckham, Kendall and Pelissier (the last three being rated equally). The Duncan strain was graded down on account of rather prominent vein in 1926. Considered from the triple standpoint of yield, grade index and judgment of quality, the Brown strain easily heads the list as it did also in the tests of 1924. The Crafts, Duncan and Peckham strains follow in the order named.

Conclusions from the three year test on Havana seed strains. As previously indicated, the first question to be answered in this series of tests was whether there are certain superior strains in the Havana seed tobacco which is grown in Connecticut and Massachusetts. To be sure, certain growers have always had the reputation of growing better tobacco, but it has not previously been shown by accurate experiment whether this was due to better land, better fertilization or cultural practices, or whether it was inherent in the strain of seed which they had. Such a problem could be answered only by growing seed from these different

growers side by side on the same land, under the same fertilization and culture and finally by keeping careful records as to yield, and sorting data and submitting the samples to expert judges of tobacco who had no knowledge of the source of the tobacco they were judging. This program has been followed now for three years as described in this and the previous report. In all the replications during this time, *no one* strain has invariably been at the top. There are, however, three, or possibly four, strains which have consistently been better and have always appeared among the highest six, viz., Brown, Crafts and Duncan, with Peckham close behind. Certain other strains have not shown up near the top in any of the tests. These trials have been conducted on different fields and under varying weather conditions. Judgment has been on the triple basis of yield, grading and quality.

These experiments prove conclusively, we believe, that there are certain strains in our Havana seed type which are inherently better than others (as well as some that are worse) and that this superiority may be depended on to remain relatively constant under varying conditions of culture, weather and soil.

Rootrot resistant strains of Havana seed. Three of the strains in this test, 148C, 142C3, 142A3, are strains which are very highly resistant to black rootrot. They have been under test at the station and in various parts of the Connecticut Valley for the last three years. In these tests it has been demonstrated beyond any question that they are very highly resistant (although not immune) to rootrot and will produce a crop where our ordinary strains will not grow tobacco worth harvesting. It has also been demonstrated that they will produce more weight per acre even on land where rootrot is not causing trouble. It will be noted in Table 10 that they produced more than a hundred pounds per acre more than any of the other strains. The only question about these strains is whether the quality is such as to meet the requirements of the trade. In the tests of the present year the experts did not rate them as high as the strains discussed above. Strain 148C in all the tests was somewhat too thin and papery. Probably if the plants were set further apart, this defect would have been less noticeable. All three of them suffered considerably from pole-sweat. This seems to be due to their ranker growth and the close setting of the leaves on the stalk. We are not yet ready to recommend that these strains be grown generally over the valley, but they should be tried out in a small way by those who have fields badly affected with rootrot.

JOHN WILLIAMS BROADLEAF STRAINS

These strain tests which have now been in progress for three years were continued in row tests on the farm of Mr. Richard P. Jones of South Windsor and on the station farm. At the latter place the growth was not entirely satisfactory on account of the very dry weather. Growth was better on the Jones farm but the tobacco was considerably damaged by storms and delay in harvesting because of continuous rain periods and by some pole-sweat.

The sorting records are presented in Table 12. According to the judgment of the experts, the Bancroft strain was best in quality. This was also true in the 1924 tests and in one of the 1925 tests. Taking into consideration all the tests of the three years, this seems to be the best strain but with the Riordan strain a close second. These are followed in order by Hambach, Vibert and Cannon. The Miskell strain has yielded heaviest but has not been rated in quality like the others. The Jones strain was very good in 1926 but has not been tested enough times to draw any conclusions yet.

TABLE 12. JOHN WILLIAMS BROADLEAF TESTS, 1926. J, ON JONES FARM, SOUTH WINDSOR. S, ON TOBACCO STATION FARM.

Source of seed		Acre yield	Percentage of grades L	M	LS	SS	2S	LD	DS	Fil	Br	Grade index†
Cannon	J	1578	2	6	32	3	22	19	3	4	9	.432
	S	....	..	..	..	..	..	..	..	..	..	....
Hambach	J	1415	3	6	25	4	20	20	5	10	7	.400
	S	1243	8	9	14	5	11	25	12	16		.385
Vibert	J	1415	2	11	34	3	16	23	2	6	3	.465
	S	1323	7	8	20	6	9	21	15	14		.400
Riordan	J	1663	8	9	28	6	13	23	2	8	3	.473
	S	1245	5	8	17	2	17	17	13	21		.358
Bankroft	J	1536	2	5	31	6	17	17	6	8	8	.419
	S	1230	9	10	15	7	15	20	9	15		.410
Miskill	J	1479	0	3	31	1	21	11	8	12	13	.369
	S	1330	3	4	16	5	14	26	13	19		.340
Grant	J	1505	0	7	37	1	19	12	2	13	9	.423
	S	1343	2	2	14	3	16	19	20	24		.292
Jones	J	1592	6	11	36	5	12	18	2	6	4	.499

† Grade index is computed on the basis of the following values for the grades.

LW	.90	SS	.50	DS	.10
MW	.60	LD	.30	Fil.	.10
LS	.70	2S	.30	Br.	.10

BANTLE BROADLEAF TESTS OF 1926

This test was on the experiment station farm at Windsor and was in duplicate. There were included five strains of seed furnished originally by:

A. E. Bidwell, East Hartford
Jacob Bantley, Glastonbury
Sherman Fox, Hockanum
J. W. Bantle, Glastonbury
Fritz Ekstrom, Glastonbury

The strains tested in 1925 from Hickey Bros. and from Benton Bros. were omitted because both had been obtained in recent years from Mr. J. W. Bantle and did not offer much chance of showing different characteristics. Yields and sorting records are presented in Table 13 and the summary of the tests of the last two years in Table 14. The low yields are due to the dry early season and to the fact that the experiment station farm is apparently not adapted to the growing of broadleaf. It will be observed from the data in the tables that the Bantley strain has been the highest yielder and also has the best grade index. The judgment of the experts placed the strain from the J. W. Bantle seed a little above but with the Bantley a close second. Judging from every standpoint we are inclined to put the strains of the Bantle broadleaf type which we have tested in the order of Bantley, Bantle, Ekstrom, with little choice between the others. Altogether, the differences between the various seed strains of this type have not been very marked. When grown side by side under the same conditions they are remarkably uniform. The rather marked differences which the dealer finds in the leaf shape and other characteristics of this type are due, we believe, more to differences in soil, culture and other environmental factors than to inherent seed differences.

TABLE 13. BANTLE BROADLEAF TEST STATION FARM, 1926.

Sourse of seed	Acre yield	Percentage of grades L	M	LS	SS	2S	LD	DS	Fil & Br	Grade index
Bidwell	1429	13	14	16	1	14	23	6	13	.448
Bantley	1439	13	14	15	2	17	20	4	15	.446
Fox	1473	11	10	17	3	14	25	7	13	.430
Bantle	1385	12	12	16	2	13	22	7	16	.430
Ekstrom	1395	11	15	16	2	11	29	5	11	.417

TABLE 14. BANTLE BROADLEAF. SUMMARY OF TESTS OF 1925-26.

Source of seed	Acre yield 1925 Sta.	1925 Handel	1926 Sta.	Ave.	Grade index 1925 Sta.	1925 Handel	1926 Sta.	Ave.
Bidwell	1140	1244	1429	1271	.248	.416	.448	.371
Bantley	1395	1454	1439	1429	.325	.519	.446	.430
Fox	1163	1415	1473	1350	.227	.505	.430	.387
Bantle	1183	1352	1385	1307	.311	.465	.430	.402
Ekstrom	1209	1490	1395	1365	.284	.485	.417	.395

FRANK ROBERTS BROADLEAF STRAIN TESTS

These tests in 1926 were on the farm of Mr. Howard Thrall of Windsor. The same eight strains which were tested during the two preceding years were grown on three different fields of the farm in single row tests. The sorting data and yields of the three tests are presented in Table 15. These strains have now been tested on seven different fields in three years. The yields of all are compared in Table 16. The differences between the strain yields are so small when the averages of the seven tests are compared that (for at least 6 or 8) they cannot be considered significant. When the grade indices for all the tests are computed we get the same result. No strain is consistently better than the others; one is a little better on one field while a different one is better on the next. The experts who have judged this tobacco during the three years have also been unable to find consistent differences in quality.

Table 15. Frank Roberts Broadleaf 1926 Tests on Thrall Farm.

Sash No.	Source of seed	Acre yield	Percentage of grades L	M	LS	SS	2S	LD	DS	F & B	Grade index
20	Roberts	1615	9	21	32	3	10	19	2	4	.530
21	Hills	1615	14	18	22	8	8	23	4	3	.528
22	Heller	1615	14	25	23	7	5	20	4	2	.553
23	McIlvane	1563	10	20	25	7	9	20	4	5	.516
24	Ensign	....	..	..	..	..	..	..	..	..	....
25	Vogel	1537	5	16	23	5	8	31	5	7	.453
26	Forbes	1492	15	18	27	4	3	20	9	4	.534
27	Evans	1537	10	21	30	3	9	16	5	6	.527
20*	Roberts	1301	4	7	33	0	21	16	9	10	.439
21*	Hills	1508	8	10	33	3	14	18	8	6	.488
22*	Heller	1346	3	7	29	3	16	23	11	8	.423
23*	McIlvane	1301	2	6	30	0	24	18	10	10	.410
24*	Ensign	1191?	7	5	27	0	24	12	8	17	.415
25*	Vogel	1279	2	5	26	1	16	16	13	21	.364
26*	Forbes	1305	9	10	25	0	20	15	7	14	.442
27*	Evans	1140	7	8	31	0	19	20	8	7	.460
20**	Roberts	1324	6	12	32	3	12	21	6	8	.478
21**	Hills	1492	1	7	33	3	18	20	11	7	.429
22**	Heller	1344	5	4	32	0	28	16	5	10	.440
23**	McIlvane	1398	1	5	27	1	15	24	14	13	.377
24**	Ensign	1344	4	5	29	2	14	24	12	10	.415
25**	Vogel	1473	2	9	30	3	13	22	11	10	.433
26**	Forbes	1499	7	13	32	3	11	16	10	8	.479
27**	Evans	1395	2	3	33	1	23	14	15	9	.374

Table 16. Frank Roberts Broadleaf Tests. Yield for 7 Tests of 1924-26.

Strain	Ensign's 1924	Ensign's 1925	Handel's 1925	Station 1925	Thrall field 1 1926	Thrall field 2 1926	Thrall field 3 1926	Average of 7 tests
Roberts	1690	1626	1381	1219	1615	1301	1324	1446
Hills	1925	1494	1230	1110	1615	1508	1493	1482
Heller	1610	1747	1331	1190	1615	1346	1344	1455
McIlvane	1610	1560	1390	1103	1563	1301	1398	1418
Ensign	1855	1698	1181	1230	1569†	1191?	1344	1438
Vogel	1680	1647	1348	1231	1537	1279	1473	1456
Forbes	1890	1682	1196	1143	1492	1305	1199	1458
Evans	1680	1693	1268	1095	1537	1140	1395	1401

† Assuming the average on this field for 1926.

Relation of Soil Reaction to Black Rootrot and Good Tobacco

M. F. Morgan[1] *and P. J. Anderson*

Over 1000 soils have now been tested for acidity. The sampling and testing of these soils has been greatly expedited through the coöperation of Messrs. B. F. Southwick of the Hartford County Farm Bureau and J. F. Owens of the Extension Service. In general, the conclusions from the first year's work (Bul. 6, p. 65) have been substantiated by the tests of the second year. We are inclined, however, to locate the safety point slightly lower on the scale than the 1925 tests would indicate. In 1925 we found all rootrot cases on soils testing above 5.95 pH (i. e., less acid than 5.95). In the early summer of 1926 (which was abnormally cold), however, we found cases in shade tobacco where the soil was slightly more acid, indicating that, for shade tobacco at least, the safety point is near 5.6. Broadleaf is more resistant and grows a good crop where shade is moderately affected. No cases of damage from rootrot have been found on soils as acid as 5.6 or below. The fact that this point is lower than in 1925 is probably due partly to the abnormally cold spring and early summer. As stated in our last report, the dividing line between rootrot and safety may be expected to shift slightly with the temperature of the soil. Again, the difference may be partly explained by the fact that a different method of testing is in use for 1926. The double wedge comparator method used in 1925 has been found to be less sensitive in the more acid range than the Morgan block method described below. Recommendations as to use of lime on soils tested are indicated in Figure 1 which has been distributed to growers who were interested in the reaction of their soils.

As far as growth alone is concerned, there have been only a few places found during this survey where the soil was too acid. On one of these, on the farm of J. E. Phelps of Suffield, experimental plots were treated with varying quantities of lime and some with acid phosphate. The response to both lime and to acid phosphate was very marked since the plots to which either considerable lime or acid phosphate had been added could be distinguished even at a considerable distance by their better growth. This response to both lime and acid phosphate lead us to believe that the active alumina liberated by the extreme acidity of the soil was the direct toxic agent in retarding growth. Further experiments with this soil, however, are in progress and will be discussed more fully at a later date.

It is a general belief that even though growth on very acid soils

[1] In charge, Soils Investigations, New Haven.

is satisfactory, the quality and burn may be improved by bringing the soil into a less acid condition through the use of lime or wood ashes. This belief seems to be substantiated by the practical experience of many farmers, but there is a great lack of scientific experiment bearing on this phase of the lime problem. Experiments which it is hoped will throw more light on this subject are now in progress at the station, but are not yet ready to report.

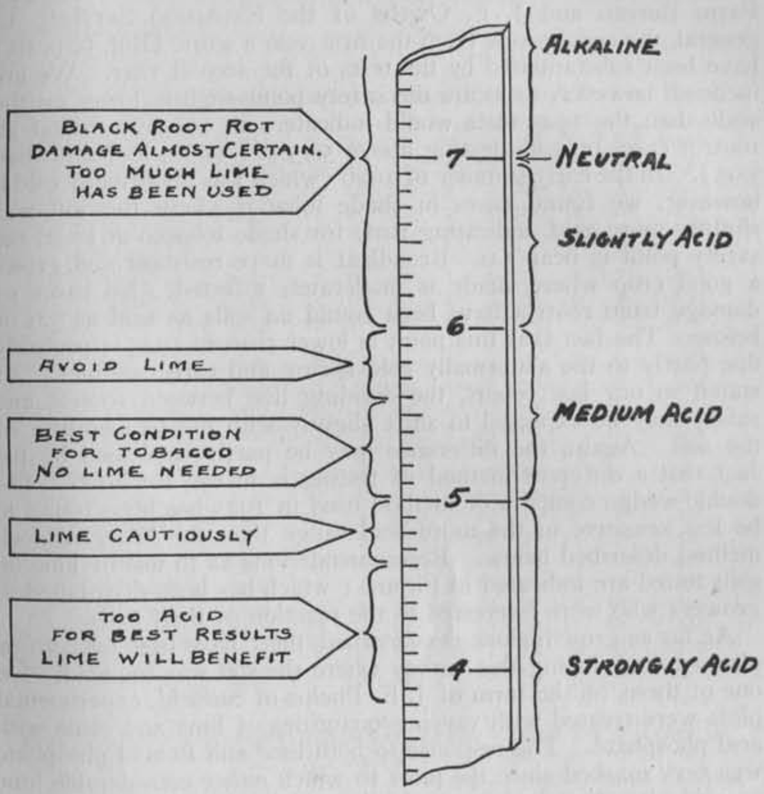


FIG. 1. The pH scale—"The Yardstick of Soil Acidity."

A NEW METHOD FOR DETERMINING SOIL ACIDITY

During the winter of 1925-26 a new method was developed by M. F. Morgan, of the Soils Department, for the rapid and accurate determination of the soil reaction in the field. This method has been used for all the soils tested at Windsor during the past year. Most of the samples have subsequently been sent to New Haven and the pH values determined by the highly accurate electrometric method. The correlation has usually been very satisfactory, and the occasional discrepancies between the two methods were usually found to be due to faulty mixing or accidental contamination of the samples.

Figure 2 shows the special porcelain block used in this field test.

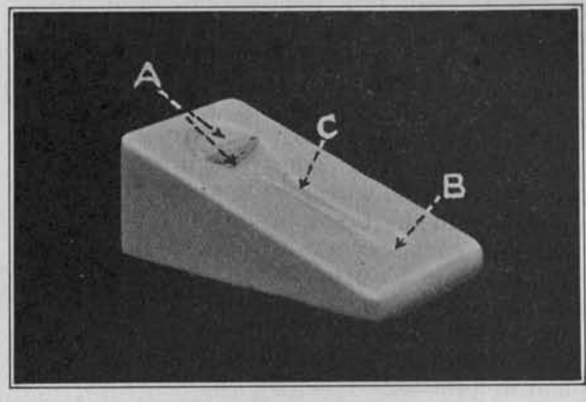


FIG. 2. Porcelain block used for soil reaction test.

Indicator solutions used are as follows:

Brom-thymol blue	(.04%)—6.0 to 7.4 pH
Brom-cresol purple or Chlor-phenol red	(.04%)—5.2 to 6.4 pH
Brom-cresol green	(.04%)—4.0 to 5.4 pH

By means of a spatula, the lower portion of depression "A" is filled with soil. By means of a medicine dropper which fits into the bottle of indicator solution, a few drops of the indicator is run into the upper portion of depression "A" until it has soaked through the soil mass and begins to run down the channel "C." If the liquid does not flow down into the depression "B" readily, it can be guided down by means of a small glass rod.

When the depression "B" is nearly full of liquid, its color is compared with a color chart showing the range of colors and pH values for the indicator used. If the color is beyond the range for that indicator, the test is repeated with the indicator for pH range above or below, as indicated.

This apparatus is being placed on the market through a commercial concern, under the name "The Morgan Soil Testing Set." It can be used by anyone who can follow directions closely, and should prove of considerable value to large tobacco growers who are interested in keeping their tobacco soils at the proper reaction.

Preservative Treatments for Tobacco Shade Cloth

H. P. Holman and T. D. Jarrell

Bureau of Chemistry, U. S. Department of Agriculture

Tobacco shade cloth is a light-weight, open, net-like, cotton fabric woven from single-ply yarns. It is used generally in the Connecticut Valley and to some extent in Porto Rico, Florida and Georgia for covering and surrounding fields of wrapper-leaf tobacco during the entire period of its growth. The cloth is usually supported by wires which are strung across the tops of nine-foot posts set eleven yards apart each way. In one direction the cloth is sewed to the wires, while in the other it simply rests on top of them. In the Connecticut Valley it is the practice to replace the cloth each season with new cloth, at a cost varying usually from $150 to $250 per acre, because it loses about half of its strength after one season's exposure and cannot be depended upon to last through a second season.

In connection with its investigations on waterproofing, mildew-proofing and fireproofing of fabrics for farm and other uses, the Bureau of Chemistry of the U. S. Department of Agriculture has for several years been trying to develop preservative treatments for tobacco shade cloth that would make it serviceable for two or three seasons instead of one. In the light of previous experience with waterproofed canvas[1] and cotton yarn[2] exposed to weather, and in view of the fact that mildew causes little damage to exposed cloth in the Connecticut Valley, it was believed that the deterioration in strength is caused by sunlight. Four years ago, in coöperation with the Tobacco Substation of the Connecticut Agricultural Experiment Station, exposure tests which continued through two seasons were started on shade cloth that had been subjected to four treatments designed primarily for protection from sunlight. Each treatment was applied to a piece of shade cloth large enough to cover two of the 11-yard squares known as "bents." Two of the treatments consisted of simply dyeing the fabric with vat dyes, in one case yellow and in the other case black. These treatments were applied by a firm manufacturing dyestuffs which firm kindly consented to coöperate to this extent. In the other two treatments pigments were used in combination with waterproofing materials that were expected to hold the pigments on the fabric. In one case burnt umber was used in conjunction with petroleum asphalt and in the other zinc oxide was used in conjunction with beeswax. Hot mineral spirits (V. M. & P. Naphtha) was used for dissolving the waterproofing material and for holding the pigment in suspension.

[1] Industrial and Engineering Chemistry, Vol. 15, No. 6, page 607, June, 1923.
[2] *Ibid.*, 15 (1923), 236.

During the same seasons about thirty small pieces of shade cloth subjected to various experimental treatments were exposed to the weather in the vicinity of Washington, D. C.

Tensile strength tests made at the conclusion of the exposure tests, which covered a total period of about 7 months, indicated that of the treatments applied to the large pieces of cloth used for shading tobacco, the pigment treatments were better than the vat-dye treatments, and that of the latter, the black was better than the yellow. Results on the small samples exposed near Washington showed that four of the treatments were better than the others. These included azulmic acid dye, oxidized azulmic acid dye, lead chromate, and burnt umber with petroleum asphalt, the last being the same treatment as was used on one of the large pieces.

No further experiments were made with the azulmic acid products because they are not generally available. But during the seasons of 1925 and 1926 exposure tests over growing tobacco were made on large pieces of shade cloth treated with lead chromate and with petroleum asphalt solution containing lampblack in place of burnt umber. The reasons for using lampblack were that this material had been found particularly effective in reducing the injurious effect of sunlight when combined with waterproofing materials for canvas, and also because it is lighter in weight than burnt umber and therefore less likely to dust off the fabric.

The treatments were applied in the laboratory with such equipment as was available. This consisted of large copper and enameled kettles and a large clothes wringer. During treatment the cloth was manipulated with the hands, protected by rubber gloves, in order to get uniform impregnation. The treated goods were dried simply by spreading out upon the grass-covered ground. In applying the lead chromate treatment the wet cloth, after being desized with malt diastase solution, was thoroughly impregnated with a 14 per cent solution of lead acetate slightly acidified with acetic acid and, after wringing but without drying, was impregnated with a 5 per cent solution of potassium bichromate. It was then rinsed and wrung out several times to remove excess of bichromate before drying. Lead chromate amounting to about 10 per cent of the weight of fabric after desizing was put on in this way. A small piece of cloth similarly treated without previously desizing gained about 17½ per cent in weight. It might, therefore, be possible to apply the lead chromate treatment without desizing. The asphalt and lampblack treatment was applied to the dry fabric, without previously desizing, by immersing the cloth in cold mineral spirits containing about one pound of petroleum asphalt and six ounces of lampblack per gallon and then passing it through the wringer. The treatment added about 50 per cent to the weight of the fabric.

It was thought that the color of the treated fabric might affect the character of growth and quality of the tobacco, and in order to permit observations being made to determine the possibility of such effects areas 22 yards by 22 yards square, or 4 bents, were covered with the experimental cloth. The office of Tobacco Investigations of the Bureau of Plant Industry, U. S. Department of Agriculture, and the Tobacco Substation of the Connecticut Agricultural Experiment Sstation coöperated by placing the cloth for the exposure tests and by making observations on growth and quality of the tobacco. These observations showed that there was no noticeable effect from the color of the treated cloth.

Tests of tensile strength after one season's exposure indicated that the cloth treated with lead chromate had lost 5 per cent of its strength, that the cloth treated with asphalt and lampblack had lost 14 per cent, and that untreated cloth had lost 47 per cent. After two seasons' exposure, cloth treated with the lead chromate was still considerably stronger than untreated cloth after one season's exposure. These results show that the lead chromate treatment is the better and that shade cloth heavily treated with lead chromate can undoubtedly be used a second season.

Further experiments with the lead chromate treatment are contemplated to ascertain the effectiveness of lighter treatments and to determine the practicability of the lead chromate treatment as a process for preserving tobacco shade cloth when modified as required for commercial application. It is not practicable to apply the treatment by hand. In any further exposure tests that may be made, it is hoped that larger areas, of at least one acre, can be covered with the experimental cloth.

Tobacco Insects in 1926.

Further Experiments on Wire Worm Control.

W. E. Britton[1] *and P. J. Anderson.*

The experiments of 1925 (Bul. 6, p. 78) proved that the tobacco wire worms will congregate in a bait crop such as germinating corn, leaving the surrounding soil practically free from worms and that calcium cyanide ("cyanogas") kills them in the soil even when not directly in contact with them. These preliminary tests, however, were on a small scale and it still remained to be demonstrated that such a method is practicable on a large scale in the field. With this as the principal object, the experiments were

[1] Entomologist, New Haven.

continued in 1926 in coöperation with Mr. A. A. Clark of Windsor and with the American Cyanamid Company of New York. The experiments were located on the shade plantation of Mr. Clark.

Most of the fields on this plantation were fall plowed and wire worms were found in the furrows in September and October. In view of the fact that fall plowing has been advocated as a means of controlling wire worms, it is interesting to note that in so far as we could judge this had no effect on their prevalence the following year. During the latter part of April, 1926, worms were found at a depth of 8-10 inches but none above this. In order to see which fields were most infested, a few rows of corn were drilled across each field on May 7. On May 20, worms were found thickly congregated in the corn on some of the fields but not on others. They were especially numerous on a field where sod had been turned under a year previously. Corn was now drilled on all of this five-acre field. A careful examination was made a week later and the worms found in great numbers (20 to 30 worms in one corn hill was not uncommon) in and around the corn, but siftings between the rows showed that there were very few there. The number of worms was much larger in the corn drilled three weeks before than in that drilled one week before.

Since it was now believed that the maximum number had congregated, the cyanogas was applied on May 31 by means of the same 2-row drill which was used in drilling the corn. The cyanogas was placed in the fertilizer attachments of the drill, from which it flowed very uniformly and was buried in the soil at a depth of 3 to 4 inches in the same rows and approximately the same depth as the corn. The rate of application was a little less than 100 pounds per acre. Two grades of cyanogas were tried, one known as the G grade and the other a coarser, cheaper grade known as granular or crude. The latter grade did not flow quite so freely and therefore the application was not quite so heavy. One strip of land 33 x 132 feet in the center of the field was left untreated as a control. Examination four days later showed that 95% of the worms were dead where the cyanogas was applied but all alive in the control. Those which were found alive on the treated part were usually in "pockets," *i.e.,* usually a bunch of live ones together. This condition led us to believe that they had escaped because a stone or some other obstruction had caused the drill to slide up to the surface of the land in places and these pockets had not come into contact with the fumes. (This land is very stony.)

In order to see whether the fumes were still toxic to the tobacco plants, some were set at this time directly in the rows where the cyanogas had been applied. From the fact that these showed no ill effect but grew normally, we are led to believe that a delay of four days between "cyaniding" and setting may be enough.

On June 7, the field was harrowed and all set to tobacco. Five days later the field was examined and the number of dead plants counted on the treated and untreated rows. It was assumed that all dead plants were so on account of wire worm attack, although close examination showed that some had died from other causes such as broken stems or insufficient roots. The percentages obtained are therefore all slightly too high. Thirty-four per cent of the untreated plants were dead. Eight per cent of the treated had died. The record for the grade G was somewhat better than for the crude cyanogas. All were restocked at that time. When they were restocked a second time at the end of another week, 12% on the control had to be replaced as compared with 2½% on the treated.

From this experiment on a large practical scale it appears that the loss from wire worms may be very materially reduced but not completely eliminated with cyanogas.

Using tobacco plants as baits. In another field which had been set three days, Mr. Clark found the infestation severe. Thinking they must have all been attracted to these plants, he set other rows directly between the original ones and at the same time cyanided the old rows. When examined a few days later, however, the new plants were found infested almost as badly as the original rows. The worms in the original rows had been killed but apparently they had not all had time yet to congregate in the early rows or else they came up from the lower strata.

In another field, corn was planted in hills of 3 or 4 grains directly in the tobacco rows several days after setting. When the worms had collected in the corn the hills were cyanided individually. Although this method was quite successful, the labor involved is rather large. It was learned during the course of this experiment, however, that when wire worms are given a choice between corn and tobacco plant they will congregate in the corn and leave the tobacco plant untouched. As many as forty worms were found in some of these hills of corn but tobacco plants no more than a foot distant were untouched. This has suggested the possibility of baiting the worms away from the growing tobacco plants until after the latter are too large to suffer from attack. If this can be done, it may not be necessary to use cyanide at all. Meanwhile the season had advanced and the worms disappeared before we had an opportunity to make an adequate test of the suggested method. It will be tried out more extensively in 1927.

GRASSHOPPERS.

Grasshopper injury was fairly common in 1926. It is always more serious where the tobacco field is adjacent to grass or other forage crops. Since in Wisconsin these pests cause a great deal more trouble than in New England, considerable experimental work has been done there to find methods of control. They have found there that they can be successfully poisoned with sodium arsenite. Dr. J. J. Johnson of the Department of Horticulture, University of Wisconsin, recommends the following formula to be used on tobacco fields:

Sawdust	100 lbs.
Sodium arsenite	1 qt.
Molasses	1 gal.
Salt	5 lbs.
Water	7-10 gals.

Ten to twenty pounds of this bait are used per acre, depending on the abundance of grasshoppers. It is spread on the ground along the edges of the field or, if the grasshoppers are numerous all over, it may be spread throughout the field.

Tobacco Diseases Observed in 1926.

G. P. Clinton[1] *and P. J. Anderson.*

As far as prevalence of disease was concerned, the season of 1926 was an average one, not characterized by any serious epidemic on the one hand or by extreme freedom from disease on the other. Continuing our custom established in 1925, the following records are made on the diseases observed.

Wildfire. In the early seed bed period no wildfire was known to be present. The first cases were found in the broadleaf section on May 28. Altogether the seed-bed infection in the Connecticut Valley was the lightest of any year since the disease first became prevalent. Not more than fifteen cases were known up to the end of June. The first infection in the field was found in Poquonock on June 15. Very few field infections were observed in the early growing season. During the continuous rains of the harvesting season, however, the little which was present spread enormously. It was more prevalent in the Housatonic Valley than usual, some fields there being totally ruined (Fig. 7).

Frost injury in the field. On the night of June 16, there was a heavy frost which caused considerable damage in the fields in some localities. Many fields were harrowed up at once and reset. When the plants were left, one to four leaves showed damage. Only the tender growing leaves were affected while the older leaves seemed normal. Seriously frozen leaves turned brown and died within a few days after the frost while less seriously frozen ones turned brown only in part. The bud was not killed except in the most serious cases and the leaves which had not

[1] Botanist, New Haven.

started at the time of the frost developed normally afterward. Some growers did not notice any injury at the time but after some weeks were perplexed by after-effects in the form of leaves curiously distorted and pinched in the lower half but normal toward the tips. The midribs were flanked by broad blanched or entirely white bars. The appearance of such plants is represented in figures 5 and 6. These leaves did not die but failed to develop normally. The rest of the plant developed normally and apparently the damage to the crop was not serious.

Rain bruise. This injury is caused by the beating of heavy rains on the underside of the leaves when they are turned over in a storm. It became especially prominent after some of the rains of late July and August. It is usually worse on one half of the leaf because the leaves are rarely turned completely over. In severe cases, irregular water-soaked patches of dark green to nearly black are evident immediately after the storm (Fig. 3-4). As the leaves dry out, however, the black areas gradually take on a purplish brown color which is retained until harvest and in severe cases shows up on the sorting bench and is the cause of considerable loss. In less severe cases the spots are apparent on the leaves in the field and may cause considerable worry but are not evident when the tobacco is cured.

Stem-rot and pole sweat. The curing season of 1926 was characterized by long continued rains which did not give sufficient opportunity for the sheds to dry out. This resulted in a considerable amount of pole sweat and stem-rot in all three types of tobacco. Charcoal fires were used very freely and prevented a great deal of trouble which otherwise would have developed but many started the fires too late to save the leaves which had already become affected.

The **bacterial angular leaf spot** (Fig. 9) was seen in less than a dozen fields about equally divided in the two valleys but not causing serious injury in either.

Various **leaf spot injuries** such as marbling, white ring, white speck (Fig. 10) were seen in various fields in about the average amount. The causes of these troubles have not as yet been determined. The evidence so far seems to indicate mechanical or chemical rather than parasitic agents.

The Fusarian spot (*F. affine*) is a leaf trouble somewhat similar to rain bruise but with more evident bronze or purplish-brown spots. It is found most frequently on the old leaves that have been in contact with the soil, especially on the broadleaf plants. It rarely causes any serious injury, being one of the minor fungous diseases of tobacco (Fig. 8). This year it was observed at three farms in Hockanum and Glastonbury.

Other diseases. Bed-rot was found in a few places. **Black rootrot** (Figs. 11-12) was observed in some beds and was unusually prevalent in the field in the abnormally cold early growing

season. Not many serious cases of **brown rootrot** were observed because when the acreage of New England was reduced by 10,000, most of the fields which had previously grown poor tobacco were eliminated. There were a few cases of **sore shin. Curly dwarf** was found in the same locality as previously. **Calico** was about as prevalent as usual, as well as the "rust" injury that often follows it. (In the interest of clarity the writers apply the term "rust" only to the dead spotted condition of the leaves following calico.)

The Heber Process of Sweating Tobacco.

P. J. Anderson

A new process of sweating by which the time is shortened to eight days—and involving certain other advantages mentioned below—has been developed by Dr. J. T. Heber of Germany and has been demonstrated at various times during the last year at the Tobacco Station where Dr. Heber has been working. Since this has received considerable publicity through the press and has created much discussion among the packers, it seems advisable that the whole process be described here and the results of the experiments conducted at Windsor briefly stated.

After tobacco leaves are cured they must go through a process of fermentation—commonly called sweating—before they are suitable for manufacture into cigars. Heat, moisture and time are required for this process. Two methods of sweating are in common use. In the first method, "bulk sweating," the tobacco is piled in large bulks of five thousand pounds and more. When it heats up to approximately 120°, the tobacco is shaken out and repiled. This process may be repeated from three to ten times and requires from three to six weeks for completion. It also involves considerable labor in shifting the bulks, and there is a shrinkage of from 5 to 10%. The above method is used mostly for shade tobacco. Other types are usually, but not always, "case" sweat. The tobacco is packed tightly in wooden cases of about 300 to 500 pounds capacity and the cases stacked up in rooms which are artificially heated to a temperature around 100°. The minimum time required for such a temperature is about six weeks.

The Heber Process may be used either for bulk or case sweating. While the hands of tobacco are being packed in the cases or laid on the bulk, each layer is lightly sprayed with the solution which contains the "active principle" of this process. The temperature of the room is then kept at 110° to 120° F. and with a humidity sufficient to keep the tobacco from drying out. This is continued for eight days and the process is complete. Experiments with up to 1000 pounds of tobacco of various pickings have been made at Windsor, some of which were taken from old tobacco soil, while others came from new soil.

The repiling of the bulk is not necessary. It would probably be necessary, however, in practice, to make the bulks smaller than they ordinarily are. The loss of weight during this process was approximately 1% during the tests conducted at Windsor.

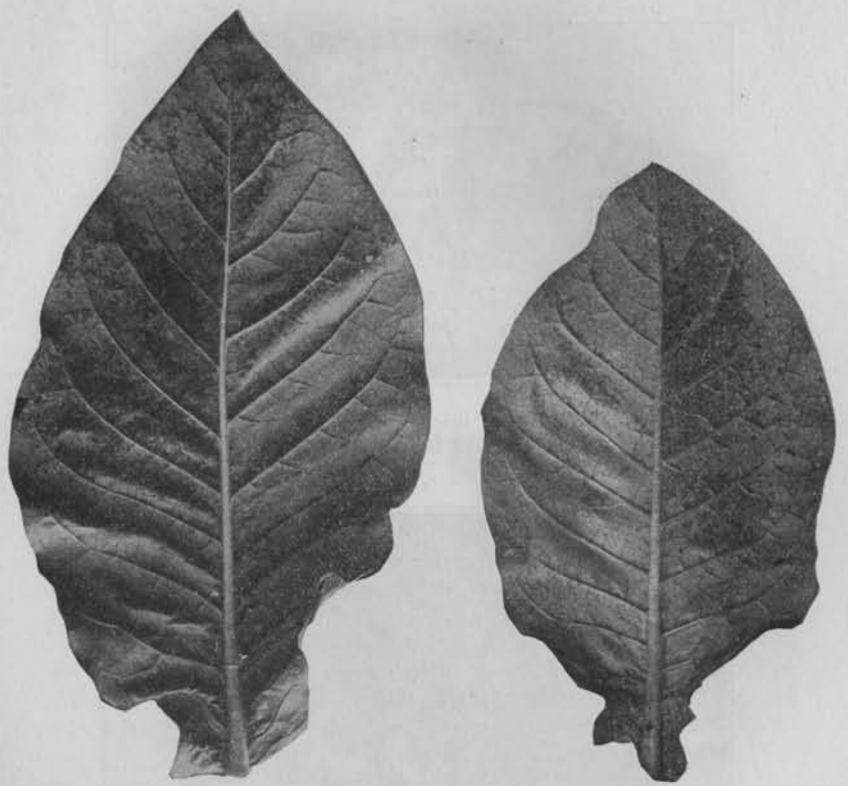
For the trade, the all important question in regard to this process is: Does it sufficiently ferment the tobacco and how does the finished product compare with that fermented by the regular process? Since there is no chemical test by which one may determine whether tobacco is or is not sufficiently fermented, it was necessary to rely on the judgment of dealers and other tobacco experts.

Shade tobacco thus treated was examined by many such experts and their opinion obtained. There was some difference of opinion; some believed that it was not fermented enough, some thought it was fermented too much. This difference in opinion may be explained by the fact that some tobacco men like the tobacco less fermented than others. The general opinion was that it was fermented about the same as when "bulked" by the ordinary process. It was also the general opinion that the leaves were lighter in color than when passed through the ordinary process. This difference in shade of color was brought out very strikingly when single leaves were divided and one half of each treated by the ordinary process and the other half by the Heber process. All agreed that the Heber process had kept the color lighter. Judged from the other points, uniformity of color, general appearance of the leaf, aroma, burn, etc., the experts could not find any consistent differences between the leaves cured by the two processes.

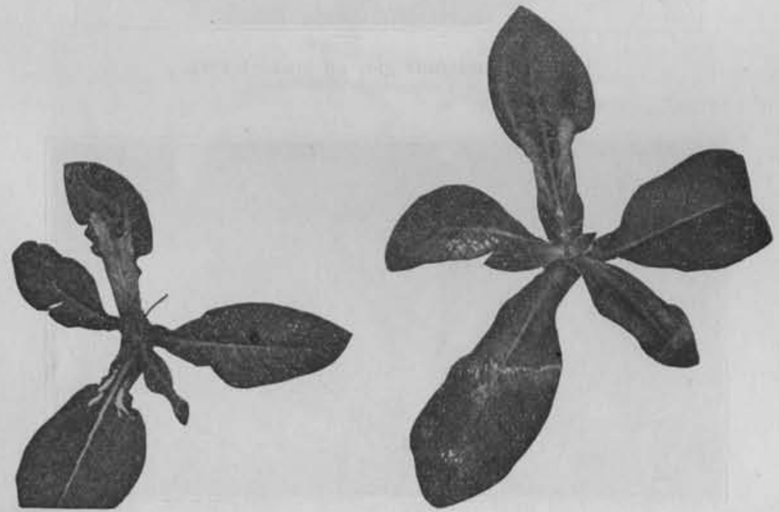
In order to determine whether the effect was due solely to the heat and moisture—rather than the Heber solution—an experiment was tried in which two boxes of tobacco were treated exactly alike except that one was sprayed with the solution and the other with an equal amount of water. When the two boxes were opened at the end of eight days, the tobacco sprayed with the Heber solution was fermented while that sprayed with water was obviously very raw and was so pronounced by the various experts who examined it.

The advantages which the Heber process may offer are:

1. Lighter shades of color
2. Less time required
3. Less loss in weight
4. Less labor
5. Less breakage



Figs. 3 and 4. Appearance of rain-bruised leaves a few hours after storm.



Figs. 5 and 6. Frost injury in field three weeks after the frost.

Plate I. Rain Bruise and Frost Injury.

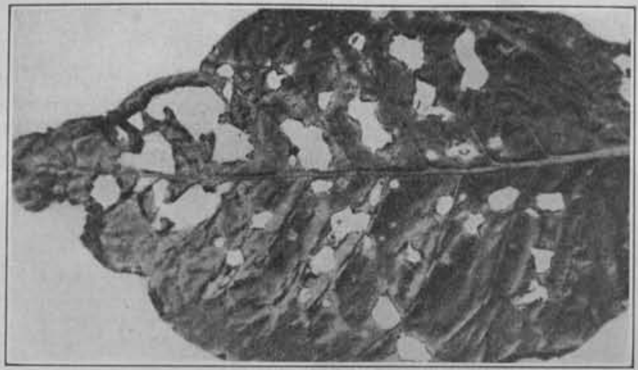


FIG. 7. Severe wildfire infection where the diseased parts have fallen out.

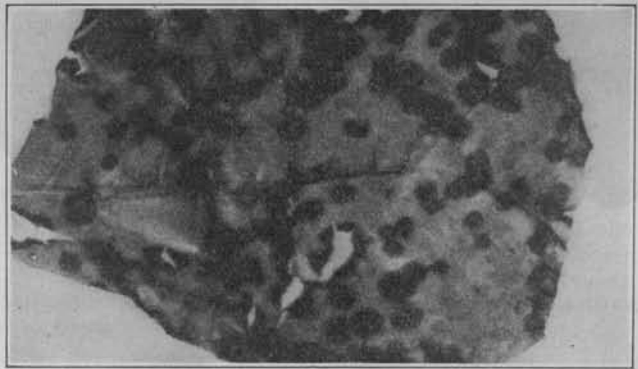


FIG. 8. Fusarium spot on lower leaves.

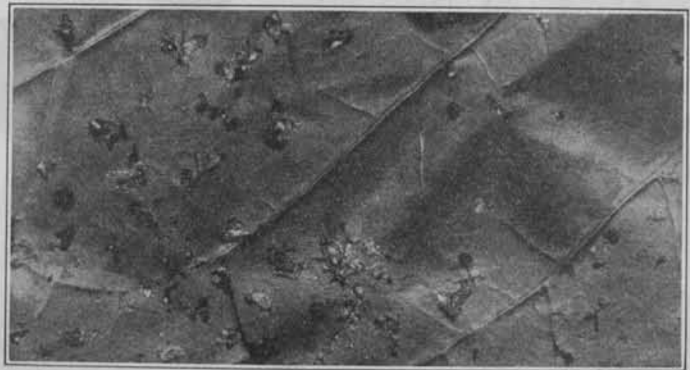


FIG. 9. Bacterial angular leaf spot.

PLATE 2. BACTERIAL AND FUNGOUS LEAF SPOTS IN THE FIELD.

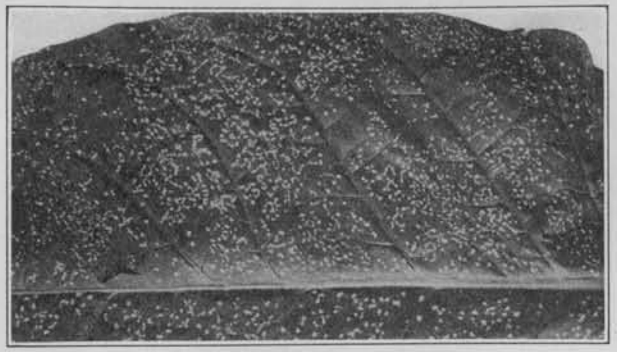


FIG. 10. White speck in the field.

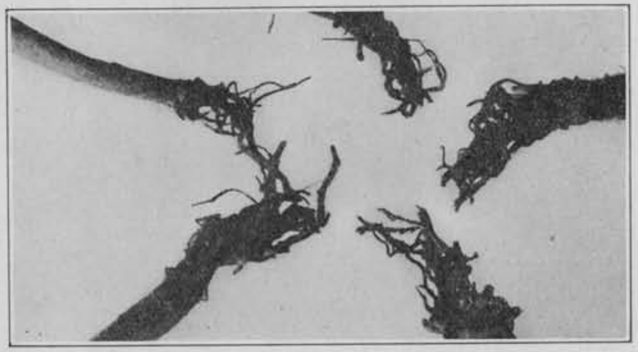


FIG. 11. Young plants with root systems totally destroyed by rootrot.

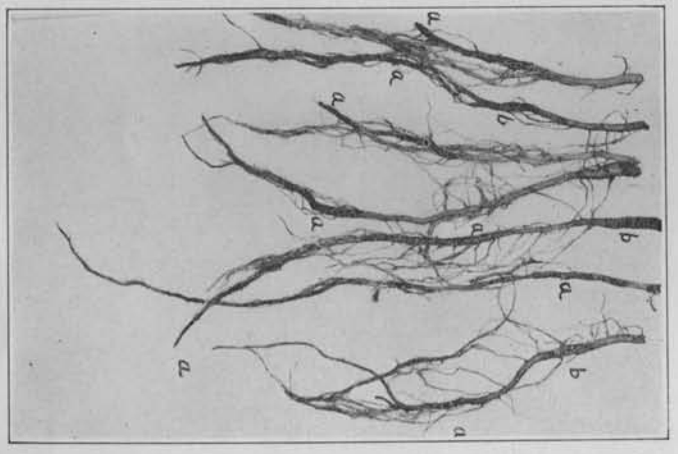


FIG. 12. Black rootrot lesions, swollen type at B, ordinary type at A.

PLATE 3 BLACK ROOTROT AND WHITE SPECK.