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WILLIS AND HUNTSVILLE

TOBACCO SOILS.

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WILLIS AND HUNTSVILLE TOBACCO SOILS.

A Preliminary Report Upon the Study of Texas Tobacco Soils and Texas Tobacco.

H. H. Harrington,
and
P. S. Tilson.

INTRODUCTION.

The subject of soil study is one of constant and increasing interest to the farmer. The soil is the only one condition, under the ordinary methods of farming, within his control. When, therefore, with some special kind of farming it becomes necessary to have a particular type of soil, the subject is of vastly increased interest. How far any particular type of soil affects the quality and type of tobacco which can be grown upon it has not been definitely determined. Still, the soil does exercise a most important influence. For example, the Perique Tobacco District of Louisiana. Dr. Whitney says: "Tobacco can be grown on any land that will produce corn and in all climates. In fact, tobacco will grow on some lands that will not raise corn. *But fine cigar tobacco will grow only in a few small localities of this earth,* where there is a peculiar formation of soil necessary to its growth. To learn where these localities are, soils must be studied, and studied carefully. I have found that all the bright yellow tobacco of Virginia, the Carolinas, and other States of the South is grown on the poorest kind of soil. The lands look like they are not worth cultivating, but there is something in the soil that produces this bright tobacco that no other soil contains. This is conclusive proof that knowing the ingredients of the soil is a very necessary attribute to successful tobacco growing. The finest cigar tobacco should be grown on a closer soil than that used for growth of the wrapper. The filler is strong and hardy, and a close soil only makes it more vigorous. But the wrapper is tender and can not stand the vicissitudes of climate and unfavorable conditions of soil like the filler."

Montgomery and Walker counties at least—perhaps others—have both these types of soil—that which will produce the finest of wrappers: a thin, light leaf with fine venation producing the finest wrapper grown in this country, and vieing with the best Cuban growth; or a leaf of more body, and of course greater weight. So that not only do we find the soil in the localities mentioned to be of the right type, but as a rule the climate is favorable. The conditions prevailing during some seasons

are especially conducive to the production of fine wrappers; for example, the rainy season of 1898.

With the same care and expense that is devoted to tobacco culture in other localities, Willis, Texas, could soon acquire a national reputation as a tobacco district. But it will require care and expense. The coarser and heavier smoking and chewing tobaccos should never be grown in the Willis district. They will thrive and do well there, to be sure; but they are so easily grown in many other localities that the soil of Willis should not be encumbered with this plebeian crop. A good wrapper leaf requires the right soil, a suitable climate, skillful and careful labor—this to get it ready for the barn. From this time on, to make of it a salable product, requires expert labor, and no other kind should ever be allowed to supervise its treatment. It will then be in value beyond the reach of the nomadic cigar-maker, a *genus homo,* from which Willis has suffered rather severely. Her goods, while of the finest kind if properly assorted and put up, have frequently brought her into disrepute because handled by men who did not know how to classify or grade tobacco to start with, and were not willing to pay the price for fine goods when recognized. This explains how it has been that Willis cigars are frequently of an uneven grade when made by the same firm. Grading and classification was not properly done, and unconsciously a poor box of cigars would follow or precede a box of fine grade. Then the rambling cigar-maker, who expected to stay but a few weeks or months, sometimes one with expert knowledge, would make a cheap cigar with a fine wrapper, a case of "quick sales and large profits." But this kind of business, as might be expected, has gradually worn itself out. Incompetent workmen and inferior goods, whether by design or ignorance, must in time result in its own failure. The result has been to dishearten for a time some of the most enthusiastic growers in the Willis district; but the experience will ultimately prove beneficial to the locality and to the industry. The opportunities there need to be more widely known, so that men of capital, with experience in their undertaking, would be willing to come and not only increase their own revenue, but to place the district in its proper rank as a pre-eminent tobacco region, not only of our State, but of our country.

One menace to the development of the industry is the unstable condition of our tariff regulations with reference to Cuba and Porto Rico: whether the present duties are to be maintained; or, if modified, to what extent. Tobacco and sugar are very much in the same condition in this respect; but in the case of the latter, it will be a struggle to maintain an already established industry; while with the former, so far as Texas is concerned at least, the consideration will hinge upon the question of putting money into an enterprise to build it up, that may at any time be handicapped by unfriendly tariff regulations.

The successful growth of tobacco may be said to depend upon the following conditions:

1. Soil and fertilizers.
2. Climate, especially the humidity and rainfall.
3. Cultivation.
4. Cutting and classification.
5. Curing and sweating.
6. We might say, *selling.*

View of a Field of Tobacco Grown for Wrappers and Seed on Farm of Owen A. Smith, Willis, Texas.

Field of Young Tobacco on Farm of Owen A. Smith, Willis, Texas.

The classification may be commenced at the time of cutting, with a subsequent assorting after curing.

It is not our purpose, however, to enter here into the details of the various steps necessary in successful tobacco culture, but to confine ourselves to a study of the soil, and, to some extent, the tobaccos grown on these soils, with such general remarks on the other processes as may be considered necessary.

CLASSIFICATION OF SOILS.

Perhaps the best division that can be made of soils, from the farmer's standpoint, is: *Sandy soils, clay soils,* and *loam soils.* These terms convey their own meaning, and are well understood by practical men generally. The texture of a soil is almost as important as its chemical composition. It should be light, without being so much so as to lose its moisture and become dry too rapidly. It is the amount of sand present which contributes to the dryness of the soil. On the other hand, it must not contain clay enough to retain an excess of water during a rainy season. A judicious mixture of sand and clay produces what we call a loam soil.

Any of the above classes, to be very fertile, must contain some decaying vegetable matter. This we call *humus,* and has an important bearing on both the chemical and physical properties and value of the soil. A clay subsoil is always desirable, and, in fact, essential, if the land is to be enduring. Yet this subsoil, even, must not be too compact. It must be able to hold the water and fertilizers from the top soil in check, and not permit them to escape by downward drainage, as a sand bed would do. On the other hand, it must not be too refractory. The particles or granules must not be so fine or small as to be a mass of compacted silt. If so, these fine particles are likely to clog the pores of the plant roots in some instances when sufficient moisture is present, and retard or prevent the full development of the plant. Clay which comes too near the surface is always objectionable. Again, a red clay is usually preferable to a white or yellow clay. While the amount of iron which it contains may be small, it is in a more desirable form than it is in the white clay. The presence of the iron itself, which gives color to the clay, is frequently beneficial, especially in a physical way. The little iron granules distributed through the soil by constant oxidation and slow solution keep the soil more or less open, and prevent compaction. Still, the unoxidized material is rarely sufficient to prove injurious to the plant.

TYPES OF SOIL AT WILLIS.

The tobacco fields around Willis and Huntsville consist of two distinct types of soil: the sandy soils, and the sandy loams. The light gray sandy soil gives a thinner leaf, and is well adapted to the growth of the Havana wrapper; but the yield in pounds is, of course, not so large. The heavier land will also give a good wrapper, particularly if the land is well drained, and if the rains are distributed so as to wash out the gum from the leaf. This land will also give a larger yield per acre. In it, the top soil extends for a greater depth, and it is, for any crop, more fertile than the sandy soil.

TIMBER GROWTH.

On the sandy land this is mainly pine. On the heavier loam land the pine is interspersed heavily with oak; some gum, hickory and chinquepin. The growth on the heavier land is taller and larger than that of the lighter land. The following table of analyses will illustrate character of soil:

SOILS FROM CARSON'S FARM.

	No. 14.	No. 13.	No. 16.	No. 15.	No. 18.	No. 17.	
Silica and sand	96.93	97.97	93.37	96.3	97.91	98.64	Per cent.
Water or moisture	.38	Trace.	.20	.11	.60	.05	Per cent.
Organic matter	.61	.74	1.72	1.15	1.01	.50	Per cent.
Oxides of alumina and iron	.96	1.13	1.39	2.43	.67	.30	Per cent.
Oxide of calcium	.17	.15	.08	.01	.04	.04	Per cent.
Sulphuric acid	.06	.18	Trace	.01	.006	.02	Per cent.
Phosphoric acid	.04	.01	.05	.04	.008	.04	Per cent.
Magnesium oxide	.09	.11	.05	.18	.08	.27	Per cent.
Potassium oxide	.02	.10	.05	.02	.01	.10	Per cent.
Sodium oxide	.04	.16	.08	.08	.09	.02	Per cent.
Totals	99.3	100.5	99.9	100.3	100.4	99.98	

No. 14 is a top soil, with a considerable amount of gravel in it, while No. 13 is the subsoil under this soil. No. 16 is from the top of the hill, near the tobacco barn, and is a light gray, sandy soil, with a considerable amount of iron in it. It had been lightly fertilized the two previous seasons. No. 15 is the subsoil of No. 16. No. 18 is a virgin soil, taken from a flat west of the railroad.

The mechanical analysis of these same soils is as follows:

	No. 14.	No. 13.	No. 16.	No. 15.	No. 18.	No. 17.	
Coarse sand	21.09	22.06	10.28	21.09	4.83	4.92	Per cent.
Medium sand	48.45	46.72	59.26	48.45	57.02	54.04	Per cent.
Fine sand	13.98	12.81	15.03	13.98	19.89	15.44	Per cent.
Very fine sand	3.91	2.61	4.12	3.91	4.52	8.47	Per cent.
Silt	9.41	7.84	7.09	9.41	7.45	11.74	Per cent.
Clay	1.90	3.60	2.30	1.90	4.68	4.84	Per cent.
Organic matter	1.15	.75	1.72	1.15	1.01	.50	Per cent.

No. 14 has rather too much gravel in it to be a desirable tobacco soil. It does not hold moisture well, and thereby suffers from drouth.

No. 16 may be regarded as a characteristic soil for the light Havana wrapper. It is thin land, open, porous, and warm. It does not produce a heavy yield, even when fertilized. But the leaf is broad and thin, with a very fine venation. During the season of 1898 it became stained or spotted with the brownish white spots considered characteristic of a fine wrapper; the same character of spots that are so often put on artificially.

While the virgin soil, Nos. 18 and 17, had not yet been put under cultivation, their type is found in other localities around Willis, and produces a fine Havana filler and a medium wrapper. The yield is somewhat heavier, and will stand a drouth better; but it is not likely to give a crop so satisfactory during a wet season.

Nos. 16 and 15 find their counterpart, to a great extent, in soils from Walker county, on the State prison farm near Huntsville, where fine Havana wrappers were grown with great success. Three samples, each of top soil, subsoil and deep subsoil were taken from these fields, and showed the following chemical composition:

CHEMICAL COMPOSITION OF TOBACCO SOILS FROM THE STATE FARM AT HUNTSVILLE.

	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.
Silica and sand	95.24	94.55	94.24	95.30	95.11	95.74
Water, or moisture	.34	.42	.28	.37	.40	.32
Organic matter	2.74	3.24	2.01	2.74	2.78	2.54
Oxide of iron and alumina	1.23	1.39	2.68	1.25	1.14	1.26
Calcium oxide	.09	.07	.18	.08	.08	.08
Sulphuric acid	.10	.08	.05	.03	.03	.02
Phosphoric acid	.07	.06	.07	.07	.08	.08
Magnesium oxide	.08	.18	.18	.07	.06	.05
Potassium oxide	.05	.06	.05	.07	.07	.04
Sodium oxide	.11	.08	.09	.08	.08	.04
Total	100.10	100.11	99.83	100.00	99.80	100.17

The *mechanical analysis* of the same soils showed the following results:

	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.
Water	.34	.42	.28	.37	.40	.32
Organic matter	2.74	3.24	2.01	2.74	2.78	2.54
Coarse sand	.12	.08	.06	.007	.09	.02
Medium sand	44.25	39.75	38.33	42.63	36.93	36.32
Fine sand	27.38	26.95	28.	28.87	29.79	28.11
Very fine sand	6.83	8.71	9.46	8.57	10.63	11.76
Silt	11.19	12.92	12.78	10.18	11.81	13.25
Clay	7.15	7.93	9.08	6.64	7.57	7.68

It is especially noticeable in both the soils from Willis and those from Huntsville that they contain a very small amount of lime. There is comparatively a small amount of organic matter, as shown by the color of the soils. This is, however, somewhat larger than was expected. Potash and phosphoric acid are present in fairly good quantity. In the typical Burley tobacco districts of Tennessee, Kentucky and Ohio, a lime soil is characteristic.

Keilebrew says, in his *Tobacco Leaf* (p. 342): "The White Burley tobacco is planted to some extent in Virginia, Tennessee, Missouri,

Maryland, West Virginia, Ohio, and Arkansas, but it usually fails when planted outside of the blue limestone soils of its native habitat to attain the excellence that makes it desirable. The farmers of each district often, after fruitless experiments, return to the cultivation of that type which has made each district famous."

This emphasizes the fruitlessness of trying to grow the Burley varieties in the Willis district, particularly when taken in connection with the fact that the Havana wrapper or filler will give better results. The only reasons advanced for the growth of the Burley is, that it requires less skill and care, and will give a larger yield per acre. But these are more than offset by the greatly increased price brought by the Cuban varieties of tobacco.

From the same author (p. 447), Dr. E. H. Jenkins reports upon the tobacco lands of Fort Meade, Fla., as follows: "The tobacco lands of the Fort Meade region are very light, deep sandy soils, finer in texture than those of the Connecticut valley, and contain some humus. They have been covered from time immemorial with a growth of wood, the best of them with oak, hickory, live oak, magnolia, etc. At the time of our visit no rain had fallen for many weeks, yet the soil was damper in appearance and feel than our Connecticut soils after two weeks of dry weather. Nevertheless, the company has put in an irrigating plant, and uses it during the growing season."

This would serve as a very good description of the heavier soils of the Willis district, while our lighter soils, still finer in texture, grow a better grade of wrapper; but the soil is not so productive.

At Fort Meade they grow the Vuelta Abajo, the same variety most successfully grown at Willis.

CONNECTICUT VALLEY SOILS.

Samples of these were shipped here for analysis, and these analyses are here introduced for comparison:

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Silica and sand	85.15	84.87	90.11	91.39	76.68	78.92
Organic matter	4.50	3.25	3.55	1.92	6.40	5.49
Moisture	1.11	.90	74	.44	1.36	1.68
Oxides of iron and alumina	7.52	9.14	4.89	5.29	11.89	10.58
Oxide of calcium	.16	.25	.12	.21	.41	.38
Sulphuric acid	.10	.08	.08	.08	.13	.18
Phosphoric acid	.46	.29	.44	.24	.38	.43
Magnesium oxide	.82	.81	.39	.37	1.70	1.58
Manganese oxide	.03	.....	.....	.....	.....	.....
Potassium oxide	.12	.11	.13	.05	.28	.28
Sodium oxide	.09	.17	.07	.04	.18	.26
Total	100.	99.87	100.5	100.	99.4	99.78

The *mechanical analyses* were as follows:

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Organic matter	4.50	3.25	3.55	1.92	6.40	5.49
Gravel	.37	.10	1.11	1.48	.....	.....
Coarse sand	1.39	.90	14.37	9.05	3.07	.34
Medium sand	20.61	5.29	41.75	44.34	14.19	.65
Fine sand	22.16	25.66	14.94	13.18	3.91	4.45
Very fine sand	18.25	20.78	10.71	6.23	15.74	20.34
Silt	22.87	26.62	8.97	16.30	32.00	36.10
Clay	8.72	16.36	3.86	7.06	23.33	30.95
Moisture	1.11	.90	.74	.44	1.36	1.68

No. 1 is the top soil from the middle level of the valley, while No. 2 is the subsoil of the same.

Nos. 3 and 4, top and subsoils, are situated on the upper side of this "middle level," while Nos. 5 and 6 are below it.

In his letter of transmission, Mr. W. F. Andross says of these soils: "The particular field from which 1 and 2 are taken is in the center of the old Podunks district, the oldest and most famous cigar leaf growing district in the United States. It is situated in S. Windsor, just across the line from East Hartford, and has grown tobacco without a change of crop for over seventy years. From this point I can walk two miles through tobacco fields without crossing any other crop; cross the street, and walk back, and not step out of a tobacco field. At harvest time the plants stand about 3½ feet high, and have an average of sixteen leaves, which run from 18 to 42 inches in length, and 10 to 20 inches wide. Its average yield is about 2000 pounds per acre. This field has been fertilized for two years with 5000 pounds of tobacco stems, 1200 pounds of castor pomace, and 600 to 800 pounds of high grade tobacco fertilizer per acre; the whole costing about $52 dollars per acre. This formula is alternated with stable manure every third year; or sometimes every other year, using ten cords per acre. This soil produces the most desirable leaf of the three levels. It will grow either variety, Broadleaf, or Havana seed. In every case the subsoil sample is taken immediately below the top soil surface. The longer the land is used for this crop the better we consider it. All the samples were in a direct line east and west as nearly as possible, the 'middle level' at this point being only eighty rods in width. The 'upper level' grows about 1800 pounds per acre, and its elevation is about 30 feet above the others, and has many sand knolls that will grow nothing. The natural vegetation is yellow pine. The quality of the tobacco grown from here is fine, and the colors usually light. Soil is somewhat warmer and earlier. Nos. 5 and 6 represent the 'lower level,' on which not much tobacco is grown, as the quality is inferior, and the combustion or 'burn' of the leaf is doubtful. Colors are darker and weights are more, sometimes reaching 2400 pounds per acre. This is about 12 feet lower than the middle level, and formed the bed of the river at some former time. It is annually overflowed by river freshets, usually in April. The soil is late and cold, but very productive. It is generally very level, and there are portions of it that are very wet."

I have thus given full space to the description of these soils as given

by Mr. Andross, because they have been considered, as he says, as coming from "the oldest and most famous cigar leaf growing district in the United States." They may be looked upon, then, by the tobacco growers of this State as a standard type. The immense yield here reported is very noticeable, but not less so than is the immense quantity of plant food supplied by fertilizers. Fifty-two dollars an acre for fertilizers. The statement seems enough to almost deter one from even considering the matter.

Dr. Whitney says of these soils: "They are too light in texture for any of the staple farm crops. They are adapted to the quick growing spring vegetables, but are not used to any extent for these crops, except immediately around the cities and larger towns. The conditions seem to be peculiarly adapted to this particular grade of wrapper leaf tobacco."

If we compare the chemical composition of these soils with those from Willis and Huntsville, the effect of the fertilizer on the former is made apparent by the large excess of organic matter, phosphoric acid and potash, over the amounts in soils of this State. It emphasizes very forcibly the necessity of fertilizers upon our tobacco lands. Yet, a great increase of fertilizers would probably necessitate irrigation in this climate, so that the crop could be kept growing continuously and pushed to rapid completion.

If we turn to a comparison of the mechanical analyses the difference is greatly in favor of the Willis soils over those of the Connecticut valley. The low amount of clay in the soils from Carson's place justifies the fine wrapper obtained in practice. *A light colored, silky leaf, of fine and pliable texture,* rivaling the best Havana leaf, can be grown upon this soil. The heavier soils, Nos. 17 and 18, represent a little heavier type of soil. They are somewhat richer, will yield a larger crop, but not quite so fine a wrapper. They are admirably adapted to the production of a fine filler, which is really the most essential part of a cigar. The binder and wrapper need not necessarily have much flavor or aroma; their physical qualities are more important: the right color, texture, body and strength, and property of burning well and evenly to a gray-white ash. The filler, making up as it does nearly all of the cigar, should carry the aroma and taste suited to the smoker. If the wrapper produces the sale, the filler must win the gratitude of the smoker. Again, the cigar manufacturer must know how to blend different tobaccos, if necessary, to cater to the taste of his trade.

The following soils were also collected near Willis and subjected to chemical and mechanical analysis:

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No 7	No. 8	No. 9	No.10	No.11	No.12
Silica and sand.....	97.65	97.54	96.92	96.07	96.32	98.27	96.31	98.23	96.77	96.28	96.43	94.62
Moisture.....	.13	.10	.09	.10	.34	.18	.37	.25	.15	.28	.29	.47
Organic matter.....	1.06	1.14	.83	2.28	1.94	.96	1.94	.88	.90	1.97	.85	2.81
Oxides of iron and alumina..	.75	1.40	1.65	1.50	1.45	.90	1.00	.75	1.40	1.40	1.95	1.55
Oxide of calcium.....	.18	.08	.30	.20	.16	.16	.16	.16	.04	.06	.06	.10
Sulphuric acid.....	.04	.05	.25	.06	.03	.03	.05	.05	.01	.05	.06	.02
Phosphoric acid.....	.01	trace	.02	.01	.04	.005	.03	.02	.01	.01	.29	.15
Oxide of magnesium	.14	.23	.30	.27	.18	.10	.28	.14	.09	.19	.18	.22
Oxide of potassium..	trace	.09	.10	.06	.37	.16	.01	.04	.04	.02	.05	.05
Oxide of sodium.....	.19	.13	.20	.26	.01	.16	.15	.10	.08	.07	.12	.10

The *mechanical analyses* of the same soils is as follows:

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No.10	No.11	No.12
Moisture	.13	.10	.09	.10	.34	.18	.37	.25	.15	.28	.29	.47
Organic matter	1.06	1.14	.83	2.28	1.94	.96	1.94	.88	.90	1.97	.85	2.81
Coarse sand	3.33	2.25	1.61	23.09	.43	.54	.21	.35	2.82	3.81	4.14	5.05
Medium sand	53.40	48.36	31.09	39.35	42.39	46.47	24.97	31.69	53.99	47.79	34.02	36.16
Fine sand	20.34	20.52	19.88	11.60	21.97	36.91	36.51	42.66	13.27	17.60	11.49	10.94
Very fine sand	2.59	4.07	11.46	2.94	22.71	6.21	11.00	8.13	7.21	7.81	7.48	3.85
Silt	1.96	15.71	25.31	15.95	8.47	5.22	12.59	8.74	16.26	15.72	20.39	24.13
Clay	17.19	7.85	9.73	4.69	1.73	3.51	12.41	7.30	5.40	5.01	21.34	16.59

No. 1 is top soil from Dr. Powell's place. No. 2, subsoil from same—red flat land. Nos. 4 and 3, top and subsoil from same place, but lighter land.

Nos. 5 and 6, top and subsoil, respectively, and Nos. 7 and 8, top and subsoil, are from different localities on the farm of Hayden & McCaleb, Nos. 5 and 6 representing the lighter land and Nos. 7 and 8 the heavier type.

Nos. 9 and 10 are from Robinson's place, and represent a heavy rich loam. It is taken from a narrow valley, and the amount of clay present gives the soil great capacity for water.

Nos. 12 and 11 are respectively top and subsoil from Carson's place, and are representative of perhaps the heaviest type of soils around Willis. They are frequently denominated "red clays," and do undoubtedly contain too much clay for the production of the finer grades of cigar leaf.

Taking all these Willis soils as a whole, one is especially impressed with the general similarity among all of them. This is true, whether we consider their chemical or mechanical analyses. They were collected from localities several miles apart, and their similarity lends importance to the district. But to the south, the extent of the tobacco soils seem limited to a few miles. This was shown from an experiment made by one of the most careful and successful tobacco growers in the Willis district. He seeded and bedded plants at Willis, and then transplanted them ten miles south; fertilized and plowed the land in precisely the same way as he cultivated his crop at Willis, the plants coming from the same seed bed. There was so much difference in the character of the crop that he found it difficult to convince his neighbors that the plants were of the same variety of tobacco. This is strong evidence that the field does not extend all over East Texas, as many seem to believe. So far as the *influence of climate* affects the crop, that is a matter that will have to be determined largely by experiment or experience. This influence of climate is perhaps the most important consideration affecting a tobacco crop. Meterological records can not be trusted to decide between this or that locality for tobacco growing. It must first be determined by actual trial upon soil that seems favorable. The two must be adapted to the crop for its successful growth.

TOBACCO ASH.

With a view of determining the character of fertilizer needed upon the Willis and the Huntsville soils for the tobacco crop, the following ash analyses were made:

ASH FROM WILLIS TOBACCO.

	No. 1.	No. 2.	No. 3.	No. 4.
Per cent of stems to the leaf	23.34	22.61	22.06	27.86
Per cent of ash in whole leaf	19.29	18.01	16.97	17.66
Sand and silica in ash	18.56	18.98	24.57	14.61
Soluble silica	2.31	1.42	1.14	1.12
"Potash"—Oxide of potassium	2.92	7.13	3.22	2.99
Oxide of sodium	7.42	7.61	6.74	5.12
"Lime"—Oxide of calcium	27.18	22.89	28.07	30.92
Oxide of magnesium	11.23	9.37	8.36	11.23
Oxide of manganese	.90	.40	Trace	Trace
Oxide of iron	.40	.56	.48	.16
"Phosphoric acid"—Oxide of phosphorous	2.50	3.97	2.91	2.69
Sulphuric acid	4.31	4.13	3.20	4.02
Carbon dioxide	20.08	18.82	17.33	24.24
Unburned carbon—"Char"	.47	.71	.68	1.37
Chlorine	1.53	2.84	2.23	.93
Total per centage	99.81	98.83	98.93	99 40

Tobacco No. 1, from which these ash analyses were made, is from light gray sandy land, a typical cigar leaf soil, except the subsoil is too near surface. The tobacco was high grade wrapper of light color from Havana grown seed of Vuelta Abajo variety. No. 2 was a filler, grown on heavier soil and darker tobacco. Sample No. 3 was grown on the heavy gray upland of Carson's place (the best type of wrapper soil), and was a high grade Vuelta wrapper. No. 4 was a rather indifferent filler from Robinson's place.

The samples of tobacco from which the ash was obtained contained nitrogen, as follows:

	No. 1.	No. 2.	No. 3.	No. 4.
Nitrogen—per cent	2.96	2.21	2.22	2.21

This per cent. of nitrogen is low compared to analyses reported from other stations. It probably results, in part, from the poor land on which the tobacco was grown, being insufficiently fertilized; and in part from the variety of the tobacco itself. The per cent. of potash is also low, while the amount of phosphoric acid appears to be about normal. Potassic and nitrogenous fertilizers are therefore mainly indicated. The percentage of total ash in the tobacco leaf is rather above the average.

KIND OF FERTILIZER TO BE USED.

As indicated by these analyses, cotton seed meal can be used to advantage in medium quantities. It is said to give an oily appearance and fine lustre to the leaf. But if used in excess, especially upon the darker soils, it is liable to darken the leaf somewhat. It is not likely, however, that any of the soils in the Willis district are sufficiently dark for the

tobacco to be injured in this way. In Connecticut castor pomace—the residue of the castor bean from which the oil has been extracted—gives very satisfactory results. But they prefer the *tobacco stems,* the mid-rib from which the leaf is stripped in the manufacture of cigars. It will be noticed that all these forms are what is termed "organic nitrogen," as distinguished from the nitrogen in nitrates and in ammonia. It is a most important generalization to the tobacco grower.

So far as the form of potash in potassic fertilizers is concerned, that afforded by cotton seed hull ashes would undoubtedly prove very beneficial; but as hulls have of late years grown too valuable to burn, we must look to some other source. Besides, it is claimed that an excess of magnesia—which is present in cotton hull ashes—is injurious to the tobacco crop. I do not believe that this claim has been proven, but still there is some evidence to support it. As the magnesia in the Willis tobacco is rather in excess—compared to the lime—it would be safer not to use any commercial fertilizer that carries much magnesia. High grade sulphate of potash could be used to advantage. Chlorides or muriates must, of course, be avoided, since the chlorine acts injuriously upon the burning quality of the tobacco. Nitrate of potash—saltpeter—would be an admirable fertilizer upon tobacco lands in general, and especially upon the Willis soils. Its cost would, of course, preclude its use upon any tobacco other than the wrapper or high grade filler.

The composition of the Huntsville tobacco ash is as follows:

	No. 1.	No. 2.	No. 3.	No. 4.
Per cent of stems to the leaf	18.18	18.18	20.95	21.10
Per cent of ash in whole leaf	24.88	23.17	19.85	18.95

One hundred parts of the ash contain:

	No. 1.	No. 2.	No. 3.	No. 4.
Sand and soluble silica	33.85	38.39	22.20	26.85
"Potash"—Oxide of potassium	7.51	6.64	12.94	12.88
Oxide of sodium	5.78	7.35	4.27	4.44
"Lime"—Oxide of calcium	21.10	16.22	19.33	17.79
"Magnesia"—Oxide of magnesium	7.18	6.88	7.14	7.28
Oxides of iron and alumina	1.48	2.36	4.36	4.00
"Phosphoric acid"—Oxide of phosphorous	2.67	2.33	5.40	4.07
Sulphuric acid	2.28	3.62	3.30	3.07
Carbon dioxide	17.87	13.55	20.00	16.00
Unburned carbon—"Char"	1.27	1.85	1.47	2.91
Total	100.99	100.19	100.47	99.29

Nos. 1 and 2 are fillers, while Nos. 3 and 4 are wrappers. Nos. 1 and 3 are from the same locality, "West of Railroad." Nos. 2 and 4 are also from one locality, near "Hog Pen."

The *nitrogen* in these samples ran as follows:

	No. 1.	No. 2.	No. 3.	No. 4.
Nitrogen—per cent	2.39	2.54	2.47	2.47

All of these are low, very much lower than tobaccos ordinarily average. The potash runs very much higher than in the Willis tobacco, both it and phosphoric acid being especially high in the wrappers. Lime and magnesia are both lower than in the Willis tobacco. In the Huntsville tobacco the large amount of "sand and silica" is especially noticeable in the wrappers over that contained in the fillers, while the amounts of potash and phosphoric acid are especially large in the fillers.

NICOTINE.

Nicotine is a vegetable alkaloid occurring in several other plants besides tobacco. It is said to occur in tobacco leaves in combination with malic acid. It is itself intensely poisonous, but it is not likely that any appreciable quantity of it is volatile in smoke. As a rule, the light colored tobacco contains less than the dark tobacco. It is less in the wrapper than in the filler. Rank growth and heavy, thick leaves usually carry large percentage of nicotine.

An excess of nitrogenous fertilizers is quite likely, therefore, to increase the percentage of nicotine, increasing at the same time the weight of the crop. It need not be inferred from this, however, that one must avoid the liberal use of nitrogenous fertilizers on tobacco, for, as shown before, they are very essential, while the amount of nicotine can be materially reduced during the sweating or fermentation of the tobacco, the nicotine undergoing oxidation. In the samples examined from Willis and Huntsville the amount of nicotine was quite small, ranging from a minimum of 1.75 per cent. in the wrapper to 2.50 per cent. in the filler.

CONCLUSIONS.

1. The tobacco soils of Willis are admirably adapted to the growth of high grade filler or wrapper.
2. Willis is perhaps the southern limit, along the I. & G. N. R. R., of the typical tobacco land.
3. The tobacco area extends north and almost certainly east.
4. A comparison of Connecticut and Willis soils shows a difference in favor of Willis for high grade Havana wrapper or filler.
5. Under conditions as at present carried out at Willis, it will perhaps be more profitable to grow the Havana filler.

But with greater outlay of capital, and especially with the introduction of shade growth, and with the application of irrigation, a most satisfactory wrapper can be grown. These improvements and the application of much larger quantities of fertilizers, must be made to bring complete and enduring success.