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TOBACCO SOILS OF CONNECTICUT AND
PENNSYLVANIA.

BY

MILTON WHITNEY,

Chief of the Division of Agricultural Soils.

[Reprinted from the Yearbook of the U. S. Department of Agriculture for 1894.]



WASHINGTON:

GOVERNMENT PRINTING OFFICE.

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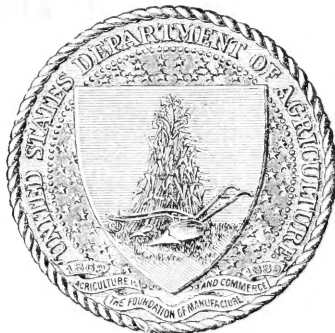
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TOBACCO SOILS OF CONNECTICUT AND PENNSYLVANIA.

By MILTON WHITNEY,

Chief of the Division of Agricultural Soils, U. S. Department of Agriculture.

Tobacco is grouped commercially into classes, types, and grades. The class represents the use to which it is adapted, whether for cigar, cigarette, smoking, chewing, or export trade. The type is dependent upon certain qualities, such as the color, texture, and flavor of the leaf, and upon the question whether it is sun-cured, air-cured, flue-cured, etc. The grade refers to the degree of excellence of the leaves from the same type or even from the same stalk. The different grades are designated as low, medium, and good, and also with respect to the use, as fillers, binders, wrappers, and the like.

Different types of tobacco are required for cigars, cigarettes, smoking, and chewing, and different grades for the wrappers and fillers of cigars and for plug tobacco. Furthermore, different sections of our own country and several of the importing foreign countries require different classes, types, and grades of tobacco for their use.

The English, German, and Italian markets require a coarse, ark, heavy type of tobacco, grown extensively in the Clarksville district of

Tennessee and Kentucky. The Austrian and Swiss markets require a lighter-colored and more leafy tobacco, which is grown upon the lighter and poorer soils of the Clarksville district. The French market requires a still lighter and coarser leaf. Nearly all of the Maryland tobacco and much of the Virginia and Ohio tobaccos go to France, Holland, and Germany for pipe smoking, as it is a mild, sweet-flavored tobacco, with free burning qualities, making it specially suitable for this use. The cigarette tobacco comes principally from the bright tobacco soils of Virginia, North and South Carolina, and eastern Tennessee.

Tobacco can be grown on almost any well-drained soil which will produce Indian corn; but the climatic conditions and the texture and physical properties of the soil so greatly modify the development of the plant as to determine the distribution of the different classes and types. Climatic conditions control, of course, the general distribution, but the influence of the texture of the soil in modifying the effect of these climatic conditions determines the local distribution of types. Tobacco readily adapts itself to a wide range of climatic conditions, as is seen in the distribution of the plant in our own country from Florida to Wisconsin. While it adapts itself very readily to the different conditions of temperature and rainfall which normally prevail during the growing season throughout this wide range of territory, seasons which are either too wet or too dry very often reduce the yield per acre and impair the quality and the value of the product. The plant is, furthermore, peculiarly sensitive to the conditions of moisture and heat, resulting under existing climatic conditions from the texture and physical properties of the different soil formations, and this largely determines the local distribution of the different types of tobacco.

ADAPTATION OF SOILS TO VARIETIES OF TOBACCO.

Soils adapted to the production of the coarse shipping tobacco, suitable for the English and German markets, will not produce fine tobacco of any variety. Soils containing a large proportion of clay, or which otherwise are very retentive of moisture, produce large, heavy plants, which cure dark-brown or red, with large quantities of oil or gum in the leaves. Light, sandy soils, on the other hand, produce a thinner leaf, which cures a very bright red, mahogany, and even lemon yellow. So marked is this influence of soil upon the quality of tobacco that a fine bright-tobacco land may be separated by only a few feet from a heavier clay soil which will produce only a coarse, heavy shipping leaf. Varieties which produce an excellent quality of tobacco on soils to which they are adapted produce an entirely different type when planted on lands of a different character, and frequently fail entirely. Yellow Pryor and Orinoco grown upon rich lowlands, especially if well manured, produce a strong, heavy type of tobacco, while upon light, new land the product of the same varieties is yellow, fine flavored, thin textured, and sweet.

Manures and fertilizers tend to increase the yield per acre, but in the case of the fine, bright tobaccos this is usually accompanied by a deterioration of the quality of the product, especially if excessive quantities of stable manure and other forms of nitrogenous manures are added to the land. With the heavier varieties of tobacco, however, this increase of yield is often accompanied by a marked improvement in the quality of the product, as it becomes richer and contains more oil and gum, which is an advantage for the purpose to which this class of tobacco is adapted.

The distribution of the principal types of tobacco may be broadly stated as follows: The seed-leaf, or Havana, tobacco is produced in such quantities and such excellence as to give a distinct character to localities in Massachusetts, Connecticut, New York, Pennsylvania, Ohio, Illinois, Wisconsin, and Florida; the red shipping leaf gives a distinct character to localities in Virginia, Kentucky, Indiana, Tennessee, Iowa, and Arkansas; the white Burley gives a distinct character to localities in Ohio and Kentucky; heavy shipping tobacco for export gives a distinct character to localities in Maryland, Virginia, West Virginia, Kentucky, and Tennessee; mahogany and yellow wrappers and smokers give a distinct character to localities in Virginia, North and South Carolina, and eastern Tennessee.

The best soils for these different classes and types of tobacco are very different, ranging from the light, sandy lands of the pine barrens for the fine yellow varieties to the heavy clay soils of the limestone areas for the heavier grades of tobacco. This must always be borne in mind, as otherwise there would be apparent contradictions, since in some districts light, sandy loams, and in others strong clay soils, are described as best adapted to the variety of tobacco which gives character to the locality.

The writer has endeavored to study during the past season the conditions maintained by the soils adapted to some of these different classes and types of tobacco for the purpose of determining those which are essential to the best development of each of these types. This information, with a knowledge of the ordinary climatic conditions, would give a basis for the classification of tobacco soils and for the improvement and modification of the conditions in many soils which are not, under present methods of manuring and cultivation, well adapted to any particular type of tobacco. This work involves considerable preliminary examination of the physical conditions of the soils in the localities which are to be selected, and then the establishment of observing stations in these different areas. It has been impossible, for various reasons, to obtain in one year records of the soil conditions from many localities and, with respect to the localities from which we have obtained records, the data are not yet all available, and will not be until the tobacco is cured.

TOBACCO SOILS OF THE CONNECTICUT VALLEY.

The influence of soil upon the quality of the tobacco grown in the Connecticut Valley is very marked. Where the soil is a heavy clay loam, or for other reasons is normally very moist, the tobacco produces a thick leaf which has considerable oil and gum in its tissues, cures a dark color, and will bear sweating well, but is not well suited for cigar wrappers at present because light-colored, thin-textured wrappers are in demand at this time. Upon light, sandy soils the quality is very fine, the texture of the leaf is thin, and the color is light. It is this type of tobacco which is at present in demand for cigar wrappers. A good wrapper for our domestic use at present requires a leaf of fine texture and small veins, but with plenty of body. It must have elasticity and strength to make it pliable in working, and it must have good sweating qualities to bring out the flavor and to give it the aroma it needs when finally cured.

Samples of the soils and subsoils have been collected from a number of localities representing some of the principal types of land adapted to tobacco and several soils not adapted to this crop. Observations have been taken every day during the growing season to determine the amount of moisture in the soils in several places.

The accompanying table gives the mechanical analyses of three of the very finest types of tobacco soil in the State of Connecticut for the light-colored, thin-textured wrappers.

TABLE 8.—*Mechanical analyses of subsoils of tobacco land.*

No.	Locality.	Moisture in air-dry sample.	Organic matter.	Gravel (2-1 ^{mm}).	Coarse sand (1-.5 ^{mm}).	Medium sand (.5-.25 ^{mm}).	Fine sand (.25-.1 ^{mm}).	Very fine sand (.1-.05 ^{mm}).	Silt (.05-.01 ^{mm}).	Fine silt (.01-.005 ^{mm}).	Clay (.005-.0001 ^{mm}).
CONNECTICUT.											
842	3½ miles east of East Hartford, "plains".....	Perct.	Perct.	Perct.	Perct.	Perct.	Perct.	Perct.	Perct.	Perct.	Perct.
1254	Poquonock	0.46	2.08	1.05	5.03	18.31	25.83	32.11	11.31	1.15	2.51
729	East Hartford, Podunk district.....	0.56	1.64	3.22	7.53	19.64	23.76	34.50	5.92	0.78	2.53
		0.49	2.05	0.09	0.30	1.11	9.95	52.47	27.73	3.56	4.00

The amount of clay in these samples ranges from 2.5 to 4 per cent. The soil of the "plains," near East Hartford, is a very light, sandy soil, which grows a tobacco of a very fine texture and very good color, but the yield per acre is naturally low. The conditions which give this land its characteristic value are undoubtedly to be found in the small content of clay and in the small amount of moisture which these "plains" soils maintain. No observations have been made on the moisture condition of these soils in their natural condition in the field.

The subsoil of the Poquonock lands is seen to contain about 2.53 per cent of clay, 5.92 per cent of silt, and less than 1 per cent of fine silt.

These soils have almost identically the same texture as the "plains" soil, and the development, texture, and color of the tobacco crop is believed to be about the same. The yield is larger in this particular locality, because the lands have been more intelligently cultivated. This is believed to represent the finest type of land of the Connecticut Valley for the light-colored, thin-textured cigar wrapper, which approaches the Sumatra grade. When heavy, dark wrappers are in style this soil can not compete with the heavy limestone soils of Pennsylvania for the domestic market.





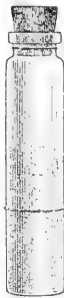



Per Cent.							
<i>Gravel.</i>	<i>Coarse sand.</i>	<i>Medium sand.</i>	<i>Fine sand.</i>	<i>Very fine sand.</i>	<i>Silt.</i>	<i>Fine silt.</i>	<i>Clay.</i>
3.22	7.53	19.63	23.76	34.50	5.92	0.78	2.53
							
2.1	1.5	.5-.25	.25-.1	.1-.05	.05-.01	.01-.005	.005-.0001
<i>Diameter of the grains in millimeters.</i>							

FIG. 4.—Mechanical separation of the gravel, sand, silt, and clay in 20 grams of subsoil from Poquonock, Conn., adapted to tobacco.

The amount of moisture has been determined in these soils throughout the growing season. The results are shown in a diagram, figure 6, page 149. The figures on the left-hand side of the diagram indicate the percentage of moisture found in the soil to a depth of 12 inches from the surface. The dotted portions of the line pass through the dates where observations are missing.

The soils of the Podunk region of East Hartford and Windsor, represented by No. 729, are seen to have about 4 per cent of clay and 27.73 per cent of silt, with 3.56 per cent of fine silt. The relatively large amount of silt makes these soils more retentive of moisture than the soils of Poquonock, and they are said to grow a rather heavier type of tobacco. The relative character of the crops of these two soils during the past season can not be exactly determined until the crops come out of the sweat and are finally cured, which requires nearly a year from the time the crop is harvested.

It will be seen that the soil of the Podunk district contained during the season considerably more moisture than the soil at Poquonock, and this undoubtedly accounts for the heavier and darker type of tobacco produced.

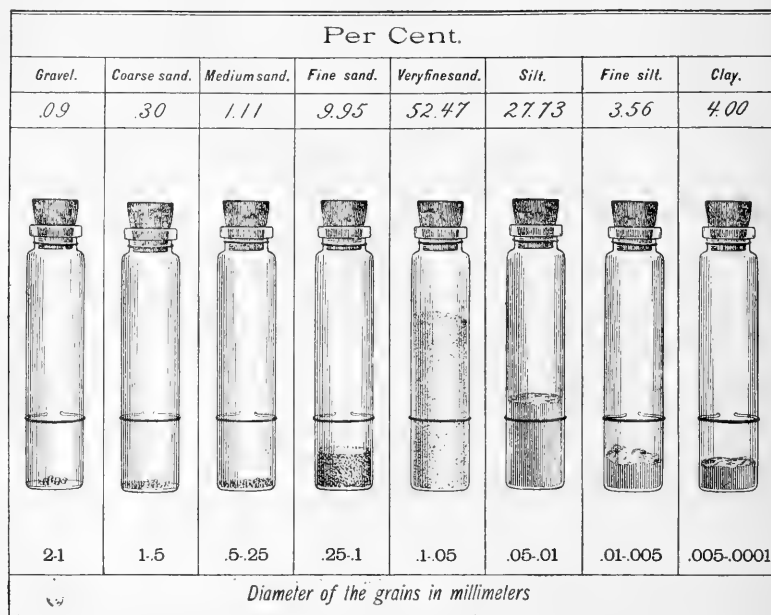


FIG. 5.—Mechanical separation of the gravel, sand, silt, and clay in 20 grams of subsoil of the Podunk district, East Hartford, Conn., adapted to tobacco.

Hatfield, Mass., is another center for the tobacco industry of the Connecticut Valley, and samples have been collected from a number of localities in that vicinity. Their mechanical analyses are given in the accompanying table.

TABLE 9.—Mechanical analyses of subsoils.

No.	Locality.	Moisture in air-dry sample.	Organic matter.	Mechanical analysis							
				Gravel (2-1mm).	Coarse sand (1-.5mm).	Medium sand (.5-.25mm).	Fine sand (.25-.1mm).	Very fine sand (.1-.05mm).	Silt (.05-.01mm).	Fine silt (.01-.005mm).	Clay (.005-.0001mm).
	MASSACHUSETTS.			Perct.	Perct.	Perct.	Perct.	Perct.	Perct.	Perct.	Perct.
1039	Hatfield, "2-acre lot".....	0.21	1.48	0.00	0.00	2.50	28.11	55.78	10.71	0.63	0.92
1173	Hatfield, representing average soils of this locality.....	0.59	2.71	0.00	0.00	0.40	9.00	42.12	38.90	3.07	3.17
875	Hatfield, 100 feet from Connecticut River.....	0.66	2.15	0.00	0.00	0.12	2.31	40.30	45.41	4.15	4.50
901	Hatfield, 200 feet from Connecticut River.....	0.82	2.90	0.00	0.00	0.21	2.13	38.11	45.09	4.76	5.98
	<i>Not suited to tobacco.</i>										
999	Hatfield, "heavy loam"....	0.88	3.45	0.00	0.00	0.10	0.43	21.88	67.00	3.41	2.61
1250	Hatfield, "meadow land"....	0.10	4.75	0.00	0.00	0.05	0.50	32.64	49.32	5.46	6.79

There are two very different types of land represented here. Sample No. 1039 came from a 2-acre lot in the town of Hatfield, considered to be of the very finest type of tobacco land of the locality. The yield per acre is small, but the color, texture, and quality of the tobacco are very superior, and the wrappers bring a high price. It will be seen that the texture of this soil is similar to that of the Poquonock and of

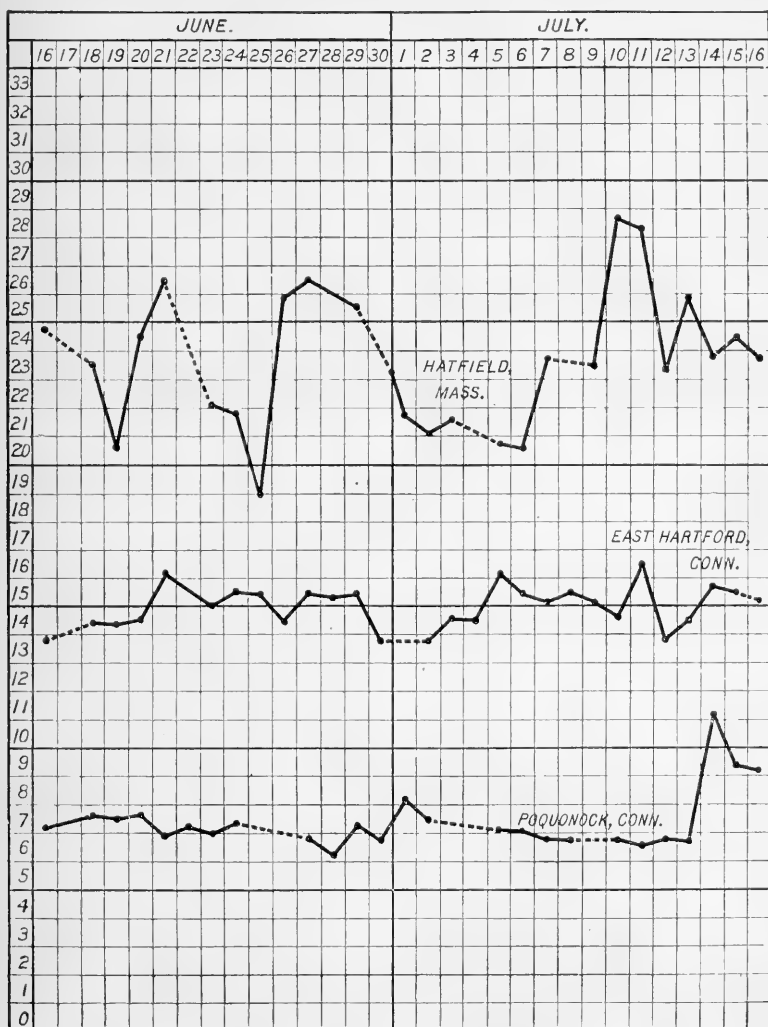


FIG. 6.—Curves showing the amount of moisture in the tobacco soils at Poquonock, East Hartford, and Hatfield, in the Connecticut Valley.

the "plains" soil at East Hartford. Sample No. 1173 represents about the average tobacco soils of the Hatfield district. This is said to produce a very fine quality of tobacco. It will be seen from the analysis that the texture of this soil is quite similar to that of the Podunk district of Connecticut. Samples Nos. 875 and 901 represent what are

called the "river sands," near the edge of the first terrace overlooking the river. They have a small percentage of clay, but a rather large amount of silt. This might make them rather too retentive of moisture, but their position on the bank of the river insures perfect drainage, as the bluff is 25 or 30 feet high at this place. For this reason these soils produce a very fine quality of tobacco, as fine in every way as does No. 1039. The importance of the bluff in securing thorough drainage to these lands is very marked. Sample No. 875 is taken about 100 feet nearer the river bank than No. 901, and the soil is considered more valuable for tobacco than the other, the product being brighter and of a finer texture.

The other two samples were taken from different types of land. Sample No. 999 represents what is locally known as a "heavy loam" and No. 1250 is from a meadow land.

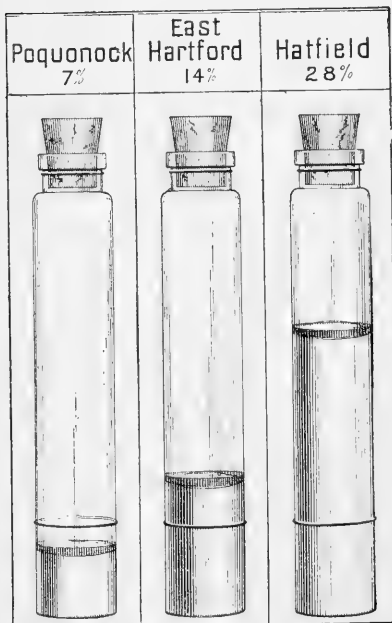


FIG. 7.—Average amount of water maintained in 20 grams of tobacco soils at Poquonock, East Hartford, and Hatfield, in the Connecticut Valley.

These two soils are said to produce tobacco the leaves of which are coarse textured and oily, do not take on a good color, and are unsuited to the present market demands; but when dark wrappers are in style these lands will be taken up and the cultivation of tobacco will be abandoned on the light soils. These soils do not differ materially from the other samples at Hatfield except in the large amount of silt they contain. Owing to this large amount of silt and to the peculiar arrangement of the silt grains, these soils are very close and very retentive of moisture, and to these soil peculiarities are due the characteristics which unfit this tobacco for the present demand. The plants show all the symptoms of an excessive growth from an excessive water supply.

The accompanying diagram (fig. 6) shows the amount of moisture maintained during a part of June and July in the soils at Poquonock, where the light wrappers are produced, in the soils of the Podunk district, and in this "heavy loam" soil at Hatfield (No. 999), which is unsuited to tobacco.

Figure 7 shows the actual amount of water maintained, on the average, by 20 grams of the soil at Poquonock, and at East Hartford, and of this heavy loam at Hatfield, through the season. The excessive amount of moisture maintained by the Hatfield soil is strikingly apparent.

It may be asked if this "heavy loam" from Hatfield is better adapted to other types of tobacco. This is undoubtedly so, but just at present the heavy, coarse types of tobacco, which in its present condition it is adapted to grow, are worth but little. It may also be asked if the conditions could be modified so as to make the land better adapted to the finer types of cigar tobacco. This could undoubtedly be done. The first thing needed would be to underdrain the land by tile drains so as to remove as much as possible of the excess of water. The tobacco should be grown on high beds or ridges, which would keep the roots in drier soil and materially improve the texture and quality of the crop. The texture of the soil should be changed by judicious methods of cropping, manuring, and cultivation, making it more loamy and less retentive of moisture. The excessive growth of the plants could be checked by cultivation, or by the use of certain manures and chemicals which would prevent the plants from taking up so much moisture notwithstanding its abundance in the soil. But all this would be expensive, and it is a question whether it could be economically done under the prevailing conditions.

TOBACCO SOILS OF PENNSYLVANIA.

The characteristic tobacco of Pennsylvania is grown on the heavy limestone soils having a stiff red-clay subsoil. These soils represent the very finest type of agricultural land, being well adapted to both wheat and grass. They are identical in geological formation, texture, and agricultural value with the soils of the Cumberland Valley of western Maryland and Virginia and with the soils of the blue-grass region of Kentucky. There are, of course, many areas along the river, on the islands, and back in other of the geological formations of the hill country where sandy soils prevail and where a light-colored, thin-textured leaf is produced. This latter type of tobacco at present has a higher market value than the crop from the heavier soils, but the type which has given character to the tobacco area of Pennsylvania is that grown upon these rich and fertile limestone soils of Lancaster and the adjacent counties. These limestone soils produce a heavy, dark type of tobacco admirably adapted for wrappers for our domestic use when dark cigars happen to be in fashion.

The fad or fancy for light or dark cigars is difficult to explain. It causes prices to fluctuate first in favor of one and then of the other of our two principal domestic types of tobacco.

These conditions should be fully realized by the tobacco planters so that they can adapt themselves to the market demands which they can not control. They should fully understand the important influence of the character of the soil on their crop. When the fashion calls for light cigars they should cultivate only their lighter soils and use their heavier lands for other crops. When dark cigars are in demand the lighter soils should be diverted from this use and the heavier soils be once more

taken up. The method of cultivation also should tend to emphasize as much as possible the differences in the conditions of these two classes of soils; the lighter soils should have perfect drainage and maintain but a small amount of moisture, while the heavier soils should maintain at all times an abundant and uniform supply of moisture.

The accompanying table gives the mechanical analyses of two subsoils of tobacco lands from the typical tobacco area of Lancaster County.

TABLE 10.—Mechanical analyses of subsoils.

No.	Locality.	Organic matter.								
		Gravel (2-1mm).	Coarse sand (1-.5mm).	Medium sand (.5-.25mm).	Fine sand (.25-.1mm).	Very fine sand (.1-.05mm).	Silt (.05-.01mm).	Fine silt (.01-.005mm).	Clay (.005-.0001mm).	
	PENNSYLVANIA.	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>Per ct.</i>	<i>P. ct.</i>
1360	Marietta.....	4.36	0.12	0.22	0.27	0.37	7.48	28.28	16.24	35.80
16	Lititz.....	5.34	0.36	0.40	0.93	3.11	11.45	30.55	10.35	36.30

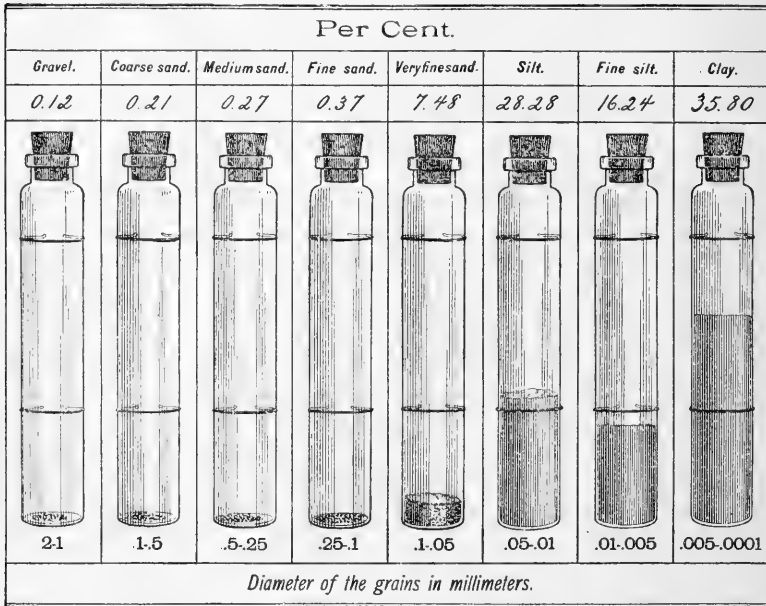


FIG. 8.—Mechanical separation of the gravel, sand, silt, and clay in 20 grams of subsoil from Marietta, Pa., adapted to tobacco.

It will be seen that these subsoils contain about 36 per cent of clay, nearly as much silt, and about half as much fine silt. They contain only a very small percentage of sand. There can hardly be a greater contrast in agricultural soils than between these heavy limestone soils adapted to grass, wheat, and the heavy types of tobacco, and the light sandy lands of the Connecticut Valley.

The accompanying diagram (fig. 9) shows the amount of moisture maintained during the month of July by the soil at Marietta, from determinations in samples taken in the field and sent in to the laboratory of the United States Department of Agriculture, compared with the moisture determinations at Poquonock and East Hartford, Conn., which have been given elsewhere.

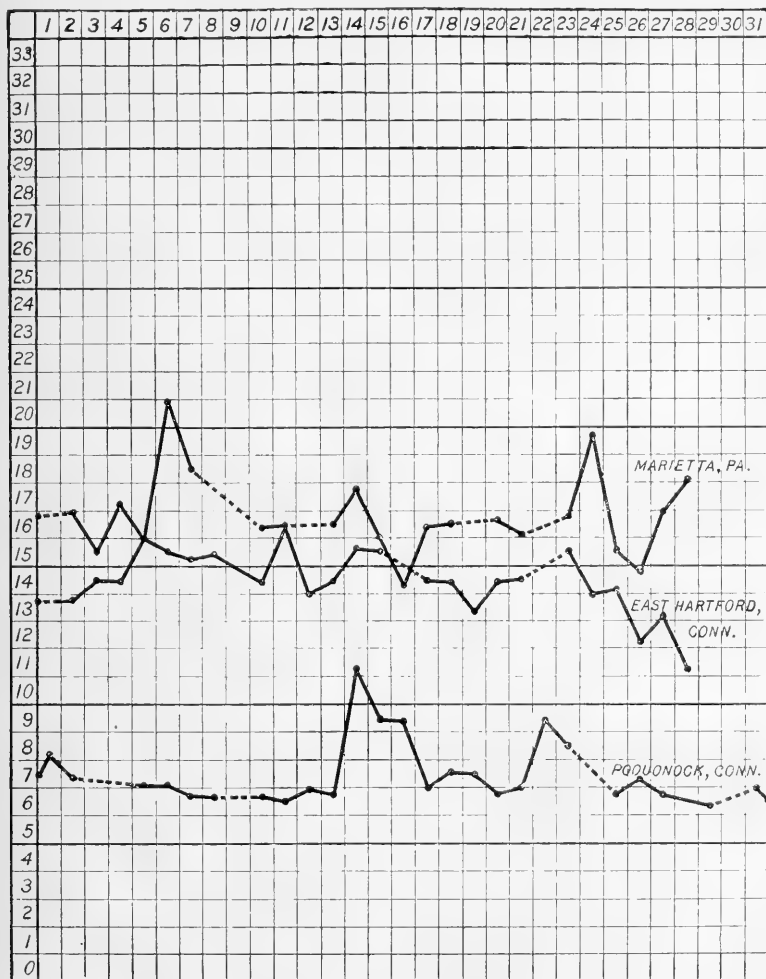


Fig. 9.—Curves showing the amount of moisture in tobacco soils at Poquonock and East Hartford, Conn., and Marietta, Pa.

It will be seen that the limestone soil at Marietta maintains nearly three times as much water for the plants as the light soil at Poquonock, and this more abundant water supply would be expected to have just the effect which is apparent in the darker, heavier type of tobacco produced.

The Connecticut Valley tobacco competes principally with the Sumatra, and the Pennsylvania with the Cuban tobacco. Our planters claim that the domestic wrappers from the Connecticut Valley have a better color and a better flavor than the Sumatra tobacco. The latter, however, has an exceedingly thin leaf, hardly thicker than tissue paper, but remarkably strong, elastic, and pliable. The veins are so delicate that they do not need to be removed. The leaves are so thin and yet so strong and cut to such advantage that manufacturers can estimate very closely how many cigars a pound of wrapper will cover. It is said to cover from four to seven times as many cigars as an equal weight of the domestic leaf. The cigars also have a smoother appearance and are thought to make a better appearance in the windows and show cases. For these reasons manufacturers have been paying from \$3 to \$5 per pound for the Sumatra wrapper rather than pay from 25 to 50 cents per pound for the domestic leaf. The problem before our planters, therefore, is to make a smaller and thinner leaf, with more elasticity and strength and with much smaller veins. The peculiar character of the Sumatra tobacco must be largely due to the climatic conditions of the island, but the same result can possibly be obtained here by close and intelligent attention to selection and breeding of varieties and by control of the soil conditions.

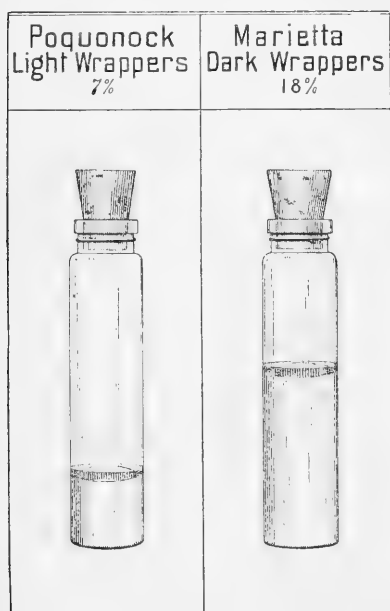


FIG. 10.—The average amount of water in 20 grams of tobacco soils of Poquonock and Marietta.

The Pennsylvania tobacco is well adapted for cigar wrappers, but it lacks the peculiar delicate flavor and aroma of the best grades of imported Havana. These qualities are undoubtedly due, in large part at least, to the tropical climatic conditions of the island. Whether these same qualities can be obtained in the same perfection under the existing climatic conditions in Pennsylvania, and if not, whether these conditions can be so controlled or changed as to give the desired qualities, can not be foretold, but offer a legitimate and promising subject for investigation. The improvement of the crop should be carried on in the lines indicated in this paper by comparing the conditions of climate, especially the conditions of moisture and temperature, within the range of the best tobacco soils of Cuba, with those conditions prevailing in Pennsylvania. When these are known they will form a basis,

otherwise wanting, for the intelligent control of the soil conditions or the improvement of methods of cultivation and treatment.

Tobacco is grown in Pennsylvania in rather small patches, the average size of the fields being about 3 acres. A small proportion of the farmers cultivate as much as 5 acres, but it is rather uncommon to have more than this, and there is a disadvantage in having more, as the crop can not be so well attended to. The crop is grown under a very intensive system of cultivation, involving great care, labor, and expense. With such small areas as these there is no good reason why planters should not insure their crop against injury by drought by having small irrigation plants which would render them in a measure independent in case of any deficiency in the rainfall. The water could be obtained either from springs or streams, of which there are a great many in that limestone area, or by pumping with a windmill or small farm engine. In the arid regions of Kansas a good windmill, it is claimed, will fill a reservoir large enough to irrigate as much as 5 or 10 acres of land, even where several applications of water have to be used during the growing season. In the tobacco area of Pennsylvania probably one thorough irrigation would carry a crop over the most prolonged drought which is there liable to occur. A reservoir 100 feet square would be sufficient to irrigate the crop, and this reservoir could be stocked with fish, which would prove a source of pleasure and profit. If it were kept constantly filled it could be drawn upon for the tobacco crop when needed, for the garden if it were conveniently located, and for other general farm purposes. The cost of such an outfit would be comparatively small; it could be made to pay by the amount of fish it would produce, if properly attended to, and as a measure of precaution and insurance against loss of the crop by drought it would be a wise investment even if it were used only once in two or three seasons.

Where there are no available springs or streams and a windmill can not well be used, a small farm engine, such as would run a thrashing machine, could be very economically employed. Such an engine attached to one of the many forms of irrigating pumps would irrigate the entire tobacco field in a day or two at a very inconsiderable cost for fuel, labor, and wear and tear of machinery. The advantage of this would be that with small driven or bored wells located on different parts of the farm the engine and pump could be moved from place to place as the different fields were cultivated in tobacco in rotation from season to season.





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