Yours truly

C

Miss Maurice

Asst Superintendent

Washington

D.C

REPORT

TO THE

BLACK OAK AGRICULTURAL SOCIETY,

ON THE

Ashes of the Cotton Stalk, the composition of Cotton Soils, and the nature of Rust in Cotton,

BY

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REPORT.

The ashes left after the combustion of plants have, until a very late period, been considered merely as accidental ingredients, that varied in quality and quantity even in the same plant growing in the same region; this incombustible part was therefore looked upon as exerting no influence on the health and vigor of the plant.

The researches of modern chemists have proved the error of this supposition, by directing their time and labor and in applying knowledge acquired in the laboratory, to agriculture and rural economy in general; and although among the many views promulgated by them, there is some error, the facts that have been brought to light, will always make the agriculturist the chemist's debtor, and should teach him to regard with proper respect what may in his eye appear to be hasty generalization.

The chemist has pointed out by analysis, that the ashes of plants of the same description, though growing in different climes, contains the same or similar ingredients. Thus, the pines of Norway and Italy when burnt, left earthy portions that are strikingly similar; these also being true of the oaks of the same countries, although these latter differed materially from the pines in the character of their ashes.

Let it not be understood, that the amount of the different substances present in the ashes of the same plant is so identical, as only to vary by the fraction of a grain; it is sufficient to bear in mind, that the leading ingredients are the same, and the whole character of the ashes such, as to enable us to infer that they belong to similar plants; the same is true for different parts of the same plants. Were it deemed necessary, numerous instances might be cited to prove the point in question, but any recent work on agriculture will convince the inquirer of this.

As the character of the ashes of plants is so invariable, it must occur to the minds of all, that they play an important part in the economy of plants, and without them plants could not grow; such a supposition the most rigid and careful experiments have proved to be correct. It being also shown that the source from whence the ashes comes is the soil, for plants create nothing, but only appropriate to themselves elements already existing; simply arranging them, so as to give rise to certain compounds—forming their woody portions from elements existing in the atmosphere and water, and their earthy parts from the soil, which must contain all the elements

necessary, as the absence of *even one* will be the cause of a sickly and imperfect growth.

Without dwelling further on this subject, every one must see the necessity of having all of the required ingredients present in the soil or of supplying them if deficient; therefore the importance of a knowledge of what is the composition of soils upon which we wish to grow certain plants. I do not pretend to say, that with a thorough knowledge of the *mere chemical composition of the soil*, all the planter's ends are to be answered, or that he will obtain the directions necessary for the improvement of his soils, as there are other properties of the soil besides its composition that influence the growth of the plant; as for instance its texture, which may be open or compact. If a soil contains all the substances a plant requires, and be compact and moist, when an open and dry soil alone is congenial to the plant, it will decay or arrive at imperfect maturity. It is for this reason that the chemist in analyzing soils has done so little for practical agriculture, he has allowed his views to become too narrowed and not examined sufficiently into other qualities of the soil. In fact the only way that practical benefit is to be derived, is, by careful investigation on their part, and patience on the part of farmers, (who must have, in other ways, seen undeniable benefits arising to them from the chemist's labors.) If this be attended to, in a few years incalculable will be their results to rural economy, and a method of analysis will be brought to bear upon soils that will answer all the required ends.

The subdivision of the parts of plants into earthy and combustible portions, belongs also to animals—in the higher orders of which, they appear in some degree separated from each other, the earthy parts constituting the mass of the bones. In others however, as the worm, insects, &c., they are intimately blended as in the plant. The prominent ingredients also of the earthy parts of the vegetable and animal kingdoms are the same, which is a natural result, as all animals *either directly or indirectly obtain their nourishment from plants.* These ingredients are *lime, phosphoric acid* and *potash*, the two first more especially, and they may be considered *par excellence* the earthy ingredients of the animal and vegetable kingdoms, without a sufficiency of which, neither one nor the other may expect a healthy growth. So then in studying soils these ingredients should particularly engross our attention as the subject of this report will show.

The ashes of a healthy cotton stalk six feet high and an inch in diameter at the largest part, with some leaves and empty pods, consists of—in 1000 *parts:—*

Lime,	303.
Potash,	243.
Phosphoric acid,	91.

Magnesia,	58.
Oxide of iron,	4.
Sulphuric acid,	13.
Chlorine,	8.
Carbonic acid,	270.
Sand,	5.

The half per cent. of sand arose from what was on external portions of the stalk and could not be readily dusted off. The carbonic acid arises from the combustion of the plant and does not previously exist in it. The chlorine that is but a little over a half per cent., the sulphuric acid which is but a little over one per cent., and the oxide of iron which is not one half per cent., may be considered as ingredients of but little if of any importance to the plant. Thereby reducing the really important ingredients to *phosphoric acid, potash, lime* and *magnesia;* this last, however, is always to be looked upon in plants, in the light of lime, and it can be replaced by lime entirely, without prejudice to the plant. The analysis which I have made of the cotton wool and seed (but which do not form a part of the report) as well as the analysis made by others of the same, show that in these also, *phosphoric acid, potash* and *lime* are the important constituents. In the analysis of your soils then, these have been particularly looked to, and with satisfactory results, except in the case of potash, which exists in such small quantities in all soils as renders it exceedingly difficult to collect and estimate; but I had hoped to overcome this difficulty if my duties did not now call me away from home.

The soils sent were marked by letters, the surface and the subsoil from the same spot being designated by the same letter marked 1 and 2 respectively.

A.—*Somerton near Somerset Creek, in* 1000 *parts.*

	1	2
Sand,	760	800
Clay,	140	155
Moisture,	30	25
Vegetable matter,	70	20

The portion of 1000 grains of the soil soluble in warm muriatic acid furnished :—

	1	2
Alumina,	3.400	3.000
Oxide of iron,	2.700	2.500
Lime,	1.200	1.300

	1	2
Phosphoric acid,	2.000	2.300
Chlorine,	trace.	trace.
Potash and soda,	trace.	trace.
Magnesia,	0.300	0.200

B.—*Chapel Hill, (Frierson's,) in* 1000 *parts.*

	1	2
Sand,	800	850
Clay,	170	132
Moisture,	10	10
Vegetable matter,	20	8

The portion of 1000 grains of the soil soluble in warm muriatic acid, furnished:—

	1	2
Alumina,	1.200	1.150
Oxide of iron,	1.100	1.200
Lime,	1.000	0.600
Phosphoric acid,	0.160	0.175
Chlorine,	0.060	0.040
Potash and soda, (chiefly soda)	0.080	0.060

C.—*Chapel Hill, (Frierson's) in* 1000 *parts.*

	1	2
Sand,	680	700
Clay,	270	252
Moisture,	20	18
Organic matter,	30	30

The portion of 1000 grains of the soil soluble in warm muriatic acid, furnished:—

	1	2
Alumina,	1.300	1.320
Oxide of iron,	1.500	1.400
Lime,	0.410	0.510
Chlorine,	0.369	0.250
Potash and soda,	0.520	0.420

D.—*Ophir, in* 1000 *parts.*

	1	2
Land,	800	850
Clay,	166	122
Moisture,	12	13
Vegetable matter,	22	15

The portion of 1000 grains of the soil, soluble in warm muriatic acid, furnished :—

	1	2
Alumina,	1.200	2.800
Oxide of iron,	1.544	1.600
Phosphoric acid,	0.294	0.367
Chlorine,	0.120	0.573
Potash and soda, (chiefly potash,)	0.030	0.450
Lime,	1.520	3.320

E.—*Pincopolis, (pine barren) in* 1000 *parts.*

	1
Sand,	900
Clay,	62
Moisture,	8
Vegetable matter,	30

The portion of 1000 grains of the soil, soluble in warm muriatic acid, furnished :—

Alumina,	0.637
Oxide of iron,	0.368
Lime,	0.125
Chlorine,	trace.
Potash and soda,	trace.

F.—*Cedar Spring near Hepworth, in* 1000 *parts.*

	1	2
Sand,	860	905
Clay,	55	50
Moisture,	25	25
Vegetable matter,	60	20

The portion of 1000 grains of the soil, soluble in diluted muriatic acid, furnished :—

	1	2
Alumina,	2.600	2.800
Oxide of iron,	0.350	0.360
Lime,	1.200	1.400
Phosphoric acid,	0.050	0.060
Chlorine,	0.290	0.280
Potash and soda, (chiefly soda,)	0.200	0.150
Sulphuric acid,	0.560	0.574
Magnesia,	0.100	0.050

G.—*Cedar Spring, western extremity, in* 1000 *parts.*

	1
Sand,	700
Clay,	253
Moisture,	22
Vegetable matter,	25

The portion of 1000 grains soluble in warm muriatic acid, furnished:—

Alumina,	0.630
Oxide of iron,	0.900
Lime,	1.100
Phosphoric acid,	0.025
Chlorine,	0.320
Potash and soda,	0.400

H.—*Somerton, (Biggin Swamp,) in* 1000 *parts.*

	1	2
Sand,	810	870
Clay,	102	95
Moisture,	28	20
Vegetable matter,	60	15

The portion of 1000 grains soluble in warm muriatic acid, furnished:—

	1	2
Alumina,	6.200	5.500
Oxide of iron,	2.300	2.100
Lime,	0.710	0.850
Phosphoric acid,	1.150	1.210
Chlorine,	0.230	0.120
Potash and soda,	0.520	0.600
Sulphuric acid,	0.510	0.300
Magnesia,	0.250	0.100

I.—*Hog-swamp, (Negrohead,) in* 1000 *parts.*

	1
Sand,	760
Clay,	200
Moisture,	10
Vegetable,	30

The part of 1000 grains soluble in warm muriatic acid, furnished:

Alumina,	2.250
Oxide of iron,	3.000
Lime,	10.400

Phosphoric acid,	0.220
Chlorine,	0.154
Potash and soda, (chiefly soda,)	0.080

this soil effervesced when the acid was poured upon it.

J.—*Hog-swamp, (W. J. Dennis' clay land,) in* 1000 *parts.*

	1	2
Sand,	730	775
Clay,	150	140
Moisture,	40	45
Vegetable matter,	80	40

The portion of 1000 grains soluble in warm muriatic acid furnished:—

	1	2
Alumina,	5.200	4.800
Oxide of iron,	8.530	8.200
Lime,	1.600	0.850
Phosphoric acid,	0.080	0.085
Chlorine,	0.044	0.025
Potash and soda, (chiefly soda,)	0.020	0.010

K.—*Mrs. Prioleau, (Ward's,) in* 1000 *parts.*

	1	2
Sand,	760	783
Clay,	130	125
Moisture,	40	42
Vegetable matter,	70	50

The portion of 1000 grains, soluble in warm muriatic acid, furnished:—

	1	2
Alumina,	5.400	4.500
Oxide of iron,	4.500	4.020
Lime,	4.620	3.210
Phosphoric acid,	0.260	0.280

L.—*A. J. Harvey's, (Dubois,) in* 1000 *parts.*

	1	2
Sand,	825	862
Clay,	140	120
Moisture,	10	8
Vegetable matter,	25	10

The portion of 1000 grains soluble in warm muriatic acid, furnished :—

	1	2
Alumina,	2.300	1.800
Oxide of iron,	1.500	1.650
Lime,	0.450	0.620
Phosphoric acid,	0.120	0.200
Potash and soda,	trace.	trace.
Magnesia,	0.130	0.150

M.—*H. Harvey's, Fair forest Swamp, in* 1000 *parts.*

	1	2
Sand,	820	875
Clay,	100	90
Moisture,	30	20
Vegetable matter,	50	15

The portion of 1000 grains soluble in warm muriatic acid, furnished :—

	1	2
Alumina,	1.100	1.500
Oxide of iron,	0.950	0.650
Lime,	0 420	0.610
Phosphoric acid,	0.060	0.080
Potash,	trace.	trace.

N.—*Eutaw, (Jas. Gaillard,) marled land, in* 1000 *parts.*

Sand,	800
Clay,	110
Moisture,	32
Vegetable matter,	58

The portion of 1000 grains soluble in warm muriatic acid, furnished :—

Alumina,	2.400
Oxide of iron,	1.680
Lime,	3.200
Phosphoric acid,	0.200
Potash,	trace.

effervesced slightly.

O.—*Eutaw, (Jas. Gaillard,) unmarled, in* 1000 *parts.*

	1
Sand,	850
Clay,	100
Moisture,	25
Vegetable matter,	25

The portion of 1000 grains soluble in warm muriatic acid, furnished:

	1
Alumina,	1.800
Oxide of iron,	1.420
Lime,	0.550
Phosphoric acid,	0.050
Chlorine,	trace.
Soda and potash,	trace.
Sulphuric acid,	trace.

P.—*Walworth, (T. W. Porcher,) in* 1000 *parts.*

	1
Sand,	720
Clay,	180
Moisture,	40
Vegetable matter,	60

The portion of 1000 grains soluble in warm muriatic acid, furnished:

	1
Alumina,	3.200
Oxide of iron,	0.900
Lime,	0.350
Phosphoric acid,	0.075
Potash,	

R.—*Mexico, (S. Porcher,) in* 1000 *parts.*

	1
Sand,	705
Clay,	250
Moisture,	20
Vegetable matter,	25

The portion of 1000 grains soluble in warm muriatic acid, furnished:—

	1
Alumina,	3.300
Oxide of iron.	2.500
Lime,	1.260
Phosphoric acid,	0.030
Chlorine,	trace.
Potash and soda,	trace.
Sulphuric acid,	trace.

The following is a tabular view of the composition of the soils.

Soil.	*In* 1000 *parts.*				*Portion of* 1000 *parts soluble in warm muriatic acid.*								Colour of the soil.
	Sand	Clay	Moisture.	Vegetable matter.	Alumina.	Oxide of iron.	Lime	Phosphoric acid.	Chlorine.	Potash and soda.	Sulphuric acid.	Magnesia	
A 1	760	140	30	70	3.40	2.70	1.20	2.00	trace.	trace.	——	0.30	
A 2	800	155	25	20	3.00	2.50	1.30	2.30	trace.	trace.	——	0.20	
B 1	800	170	10	20	1.20	1.10	1.00	0.16	0.06	0.08	——	——	
B 2	850	132	10	8	1.15	1.20	0.60	0.17	0.04	0.06	——	——	
C 1	680	270	20	30	1.30	1.50	0.41	——	0.36	0.52	——	——	
C 2	700	252	18	30	1 32	1.40	0.51	——	0.25	0.42	——	——	
D 1	800	166	12	22	1.20	1.54	1.52	0.29	0.12	0.03	——	——	
D 2	850	122	13	15	2.80	1.60	3.32	.0.36	0.57	0.45	——	——	
E	900	62	8	30	0.63	0.36	0.12	——	trace.	trace.	——	——	
F 1	860	55	25	60	2 60	0.35	1.20	0.05	0.29	0.20	0.56	0.10	
F 2	905	50	25	20	2.30	0.36	1.40	0.06	0.28	0.15	0.57	0 05	
G	700	253	22	25	0.630	0.90	1.10	0.02	0.32	0.40	——	——	
H 1	810	102	28	60	6.20	2.30	0.71	1.15	0 23	0.52	0.51	0 25	
H 2	870	95	20	15	5.50	2.10	0.85	1.21	0.12	0.60	0.30	0.10	
1	760	200	10	30	2.25	3.00	10.40	0.22	0.15	0.08	——	0.38	
J 1	730	150	40	80	5.20	8.53	1.60	0.08	0.04	0.02	——	——	
J 2	775	140	45	40	4.80	8.20	0.85	0.08	0.02	0.01	——	——	
K 1	760	130	40	70	5.40	4.50	4.62	0.26	——	——	——	——	
K 2	783	125	42	50	4.50	4.02	3.21	0.28	——	–	——	——	
L 1	825	140	10	25	2.30	1.50	0.45	0.12	——	trace.	——	0.13	
L 2	862	120	3	10	1.80	1.65	0.62	0.20	——	trace.	——	0.15	
M 1	820	100	30	50	1.10	0.950	0.42	0.06	——	trace.	——	——	
M 2	875	90	20	15	1 50	0.650	0 61	0.08	——	——	——	——	
N 1	800	110	32	58	2.40	1.680	3.20	0.20	——	trace.	——	——	
O	850	100	25	25	1.30	1.42	0.55	0.05	trace.	trace.	trace.	——	
P	720	130	40	60	3.20	0.90	0.35	0.07	——	trace.	——	——	
R	705	250	20	25	3.30	2.50	1.26	0.03	trace.	trace.	——	——	

From these analysis I should certainly conclude that *A* and *H* were the best soils, on account of the larger proportion of phosphoric acid contained in them. Of these two, I am disposed to think that *H* will be found the better, from it containing more potash, chlorine, and sulphuric acid than *A*, although it has not quite as much phosphoric acid; a little dressing of leeched ashes placed immediately around the plant, will very probably improve the growth of the cotton. The next best, according to these analysis, would appear to be *B. D. I. K. L. N.*. But *B. D.* and *K* are said to rust cotton, the cause of which I will allude to in another part of this report, at least so far as I have been able to make it out. All the others I should consider as being able to grow cotton fairly, except *E*, which would appear to be unfitted for almost any plant.

It is not the province of this report, to enter upon the various methods of improving these cotton soils, but it may not be out of place, to state one thing that occurs to my mind, bearing upon the wants of the plant, and character of the soils. It is, to let the la-

borer when he thins out for the last time, carry with him a bag containing a mixture of ground bones, (about as fine as river sand) mixed with an equal quantity of leeched ashes, and at the root of every stalk he leaves standing, throw a good handful immediately around it. In fact there is little doubt but that it will be found far more beneficial as a manure than cotton seed, and requiring a much less quantity.

The Ashley river marls and all such marls as contain from 4 to 10 per cent. of phosphate of lime, will answer well to put on the top of the ridges after the planting of the seed.

In a letter received from Mr. F. A. Porcher, accompanying the soils, he stated, that *F* and *G* are representations of soils not very rich, but very safe; and reference to my analysis will bear this out. I should have stated, although I have no mention made of what sort of soil *C* is found to be, that I consider it a very inferior one. If any general conclusion can be arrived at from the analysis, it is, *that cotton soils—every thing else being alike—is valuable according to the amount of phosphoric acid present.*

The last point to be considered in this report is that of *rust* in cotton, and here every thing is to be learnt. *Rust*, as a term in agriculture, is in about the same position as that of dispepsia in medicine. It is a name given to a variety of diseases which have some resemblance to each other, but are widely different as to their causes. The rust properly speaking, and which so commonly attacks wheat, is certainly a kind of parasitic plant of the class of fungi, that grows on the stalk, leaves, &c., of the wheat and other grain, under certain disadvantageous circumstances of weather and season. The seeds of this parasite are wafted by the breeze to the spot where it germinates; it takes root into the body of the stalk and interrupts the maturation of the seed. This rust is somewhat the color of iron rust, from which it derives its name; it readily detatches itself, and when burnt, leaves a little ashes. Now I am not aware that rust of this description has ever been known to infect cotton, that which attacks cotton shows no fungus growth, but under the effects of it, the plant becomes blighted, changes in color and dies.

To arrive at the true cause of the rust of cotton, the planter will have, by very close examination, to distinguish between the different kinds (if there be any difference) and mark well the influences that are operating upon the plant at the time they occur. When he goes as far as he can in this, let him call to his aid the chemist, give him the *rusted cotton stalk* and a *healthy cotton stalk of precisely the same size and growth*, as well as a portion of the soil taken up at the time the effects are noted. In acting in this way, the planter may hope to find out the causes of this blight, and they will of course point out the remedy, which if practicable, will meet all the wishes and repay the labor of the planter. It is not a rigorous method of comparison, to examine the ashes of healthy and diseased plants, unless they are of the same stage of growth, for ashes of plants differ with their age. Wheat-straw, just before the grain begins to form, contain some of

those ingredients that afterwards abandon to a great degree the straw and pass into the grain, making a decided difference between the ashes of young and matured wheat straw.

My examination into the cause of the rust is very imperfect, not having been furnished, as you must now see, with the proper data to go upon in my investigation; but what has been done shall be made known to your body. I have no doubt that the peculiarity of seasons may produce these diseases as well as animalculæ developed in the soil; but my firm belief is, that noxious substances in the soil are frequently the causes, and they are more commonly some of the preparations of iron—the *protoxide of iron* especially. This protoxide was found by me in much larger quantities in *D* and *K*, particularly in *K*, than any of the other soils, in fact some of them contained none of it.

I can pronounce with but little confidence upon any thing brought to light by the analysis of the cotton stalks, for the healthy and rusted stalks placed in my hands, differed too much in size and age, to furnish much information from the comparative composition of their ashes. But I did all that it was possible to do under the circumstances. There was decided difference in the amount of *oxide of iron* in the two ashes: in the ashes of the full grown healthy plant, it was only *one half per cent.*, while in the ashes of the one diseased, it was *two and a quarter* per cent. The phosphoric acid of the two did not differ materially, the healthy having nine, and the diseased eight per cent. The proportion of lime was different, the diseased forty, and the healthy thirty per cent. The proportion of potash in the diseased was fifteen per cent., while that of the healthy stalk was twenty-four.

The protoxide of iron alluded to above, is by exposure to the atmosphere, converted into the peroxide, a form from which no injurious effect may be expected, except when in very great excess; so I would suggest that in planting these lands, which rust cotton, as *D* and *K*, to disturb the surface as little as possible. This I know to answer in the case of certain soils that were examined for Dr. Townsend, of John's Island.

I am sorry that my unavoidable absence from America, will render it impossible to prosecute these labors, commenced under the auspices of your Society, and I regret it the more since much time has been consumed in fixing upon methods best suited for carrying on these investigations. I hope, however, that the active part taken by you in inquring into the true nature of the circumstances governing the growth of cotton, will be crowned with the success it deserves, and that the report may aid in pointing out the right course to be pursued.

Hollinger Corp.
pH 8.5