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DIVISION OF CHEMISTRY

THE CHEMICAL COMPOSITION OF THE COTTON PLANT

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THE CHEMICAL COMPOSITION OF THE COTTON PLANT.

BY G. S. FRAPS, PH. D., CHIEF, DIVISION OF CHEMISTRY; STATE CHEMIST.

The knowledge of the composition of the cotton plant is important from several points of view. In connection with soil studies it is important to know how much plant food the plant takes from the soil. The amount of plant food required by the cotton plant is important in connection with the fertilization of cotton, and the chemical composition of the cotton plant throws some light upon this subject. Plants, however, may take up more plant food than is really needed by them when an abundance is present, and this applies particularly to potash, which may be taken up in large excess. The feeding values of cotton stalks and leaves are of significance in connection with the fact that cattle are turned into the cotton fields to graze, partly for the purpose of destroying the boll weevil. In some cases the burs which collect at cotton gins are also fed.

A summary of the chemistry of cotton up to 1896 is published in a book entitled "The Cotton Plant," published by the United States Department of Agriculture. Analysis of cotton leaves, seeds, stems, and lint are published by C. B. Williams in the Bulletin of the North Carolina Department of Agriculture, September, 1906. Some analyses of the cotton plant grown with different amounts of fertilizer, at different stages of growth, are published in Bulletin 114 of the Georgia Experiment Station, July, 1915.

METHOD OF WORK.

One set of samples was secured by collecting all of the cotton plants on an area of 200 square feet. The plants were then separated into leaves, stalk, bolls, burs, and seed cotton. This was done on October 6,

Table 1—Cotton grown in the experiments.

Variety	Station	Pounds Per Acre Seed Cotton	No. Plants Per Acre 100% Stand	Actual Stand	Actual No. Plants Per Acre
Mebane	Troup	730	9680	83	8024
Crenshaw	Troup	750	9680	62	6001
Mortgage L	Temple	636	9680	98	9487
Mebane	Temple	804	9680	100	9680
Mebane	Lubbock	389	17446	75	13085
Rowden	Lubbock	169	17446	75	13085
Mebane	Beeville	1170	7260	80	5813
Rowden	Beeville	1049	7260	85	6176
Burns	Nacogdoches	550	15840	90	14256
Mebane	Nacogdoches	660	15840	90	14256
Rowden	Denton	623	8690	75	6518
Mebane	Denton	967	12430	85	9965

1910, on cotton grown at College Station. The other analyses were made on four average cotton plants, selected as being of average size and characteristics by the superintendents of various substations, and sent by them to the chemical laboratory. The plants were then separated into the various parts, weighed and subjected to analysis. As all the plants had dried out to some extent during transit, the quantity of water lost in preparing the samples for analysis is not of significance, and is not given. The estimate of the yield per acre is based upon the total number of plants actually grown per acre in the plots of the different varieties at the substations. See Table 1. Acknowledgment is hereby made to the various superintendents who sent in the samples. The yields of seed cotton are those secured in the experiments at the substations on the plots from which the plants for analysis were taken.

Table 2—Average percentage composition as dried for analysis.

	Phosphoric Acid	Nitrogen	Potash	Lime	Magnesia	Silica
Stalk, Texas	0.24	1.12	1.23	1.12	.54	.16
Stalk, "The Cotton Plant"	.59	1.46	1.41	.97	.42	.....
Seed Cotton with Lint, Texas	0.71	2.22	1.01	.37	.33	.35
Leaves, Texas	0.42	2.55	1.64	6.42	1.38	1.47
Leaves, "The Cotton Plant"	1.19	3.21	1.80	4.44	0.87	.....
Burs, Texas	0.26	.96	3.55	1.51	0.44	.61
Burs, "The Cotton Plant"	.48	1.08	2.66	1.80	.43	.....
Bolls with Seed and Lint, Texas	0.57	1.88	1.86	.93	.58	.25
Bolls, "The Cotton Plant"	0.96	2.54	1.81	.51	.40	.....
Lint, "The Cotton Plant"	0.10	0.34	0.46	.19	.08	.....
Seed, "The Cotton Plant"	1.27	3.13	1.17	.25	.55	.....

MINERAL COMPOSITION.

Table 2 shows the average composition of the various parts of the cotton plant as found in these experiments, and Table 3 gives the detailed results of the analyses of the samples from the different stations. The average nitrogen content of the seed is estimated from a large number of analyses published in Bulletin 189.

Table 3—Mineral composition of seed with lint.

	Phosphoric Acid	Potash	Lime	Magnesia	Silica
6638 Rowden	.....	.92	.....	.....	.....
6643 Crenshaw Cotton	1.09	1.18	.56	.41	.56
6648 Triumph	1.07	1.01	.28	.32	.47
6653 Mortgage Lifter	.42	1.07	.....	.....	.....
6658 Mebane	.....	.70	.28	.19	.18
6671 Burns Long	.39	1.03	.....	.....	.....
6676 Mebane	.47	1.07	.36	.41	.20
6707 Rowden	.72	1.12	.....	.....	.....
6712 Local Cotton (Mebane)	.81	1.02	.....	.....	.....
Average	.71	1.01	.37	.33	.35

Table 3—Cotton Leaves.

	Phosphoric Acid	Nitrogen	Potash	Lime	Magnesia	Silica
3178 Cotton Leaves	.38	2.65	1.72	.....	.....	.....
6634 Mebane Triumph	.32	2.27	2.02	6.79	1.57	.48
6639 Rowden	.34	.....	1.66	6.68	1.58	1.61
6644 Crenshaw	.44	2.67	1.11	6.05	1.63	6.22
6649 Triumph	.43	2.62	0.66	5.29	1.56	2.34
6654 Mortgage Lifter	.28	2.24	1.27	7.54	1.22	.47
6659 Mebane	.27	2.26	1.70	6.92	1.57	.56
6669 Mebane	.55	3.01	2.08	6.42	1.20	2.58
6672 Burns Long Staple	.37	1.95	2.03	4.26	.80	.95
6677 Mebane	.42	.....	1.69	5.18	1.09	1.15
6704 Rowden	.50	2.72	1.61	5.11	1.40	0.69
6709 Local (Mebane	.66	2.71	1.60	7.83	1.51	0.60
6665 Rowden	.49	2.92	2.24	8.97	1.42	2.03
Average	.42	2.55	1.64	6.42	1.38	1.47

Table 3—Cotton Bolls with Seed and Lint.

	Phosphoric Acid	Nitrogen	Potash	Lime	Magnesia	Silica
3180 Cotton Bo"s	.43	1.69	2.80	.....	.....	.....
6635 Mebane Triumph	.50	2.42	1.95	.31	.73	.18
6640 Rowden	.60	.....	1.92	3.05	1.17	.72
6645 Crenshaw	.80	1.94	1.45	.56	.53	.43
6650 Triumph	.76	.....	1.26	.46	.42	.22
6655 Mortgage Lifter	.27	2.07	1.80	.....	.....	.....
6660 Mebane	.37	1.81	1.60	.....	.....	.....
6668 Mebane	.67	2.64	2.32	.83	.43	.11
6674 Burns Long Staple	.68	1.18	1.98	.....	.....	.....
6679 Mebane	.43	1.48	1.48	.50	.38	.03
6706 Rowden	.50	1.72	1.65	.....	.....	.....
6711 Local (Mebane)	.77	2.01	1.91	.....	.....	.....
6664 Rowden	.65	2.14	2.64	.81	.43	.05
Average	.57	1.88	1.86	.93	.58	.25

Table 3—Cotton Burs.

	Phosphoric Acid	Nitrogen	Potash	Lime	Magnesia	Silica
3179 Cotton Burs	.69	2.30	2.00	.....	.....	.....
6632 Mebane	.13	.69	3.83	.....	.....	.....
6637 Rowden	.13	.68	3.32	1.61	.49	.34
6642 Crenshaw	.44	.....	2.83	1.29	.45	1.95
6647 Triumph	.39	.....	3.43	1.14	.37	.58
6652 Mortgage Lifter	.12	.....	3.23	1.93	.33	.28
6657 Mebane	.10	.89	4.16	2.16	.56	.32
6673 Burns Long Staple	.15	.58	3.20	.90	.43	.22
6678 Mebane	.19	.52	3.84	.....	.....	.....
6705 Rowden	.22	.96	3.77	.....	.....	.....
6710 Local (Mebane)	.27	1.04	4.48	.....	.....	.....
Average	.26	.96	3.55	1.51	.44	.61

Table 3—Cotton Stalks.

	Phosphoric Acid	Nitrogen	Potash	Lime	Magnesia	Silica
3177 Cotton Stalk	.33	1.51	1.30	.....	.....	.....
6631 Mebane Triumph	.23	1.15	.47	.....	.....	.....
6636 Rowden	.13	1.13	.86	.....	.....	.....
6641 Crenshaw	.29	1.42	1.03	.81	.38	.03
6646 Triumph	.14	0.90	1.11	.96	.50	.04
6651 Mortgage Lifter	.19	1.10	.91	1.29	.54	.17
6656 Mebane	.18	1.06	1.07	1.49	.75	.33
6663 Rowden	.31	1.45	2.23	.....	.....	.....
6670 Burns Long Staple	.19	.66	1.09	.....	.....	.....
6675 Mebane	.14	.65	1.10	.72	.44	.08
6703 Rowden	.21	.89	.90	.....	.....	.....
6708 Local	.45	1.07	1.12	.....	.....	.....
6667 Mebane	.35	1.54	2.76	1.44	.65	.23
Average	.24	1.12	1.23	1.12	.54	.16

The cotton leaves are decidedly much higher in nitrogen and potash than those analyzed in North Carolina, but the Texas average is lower than the average given in "The Cotton Plant." The bolls and burs are high in potash, while the stalks are not nearly so high in plant food as might be expected.

RELATIVE PROPORTION OF PARTS.

Table 4 contains the amount of stalks, leaves, etc., estimated per acre, and Table 5 shows the amount which accompanies 300 pounds of seed cotton. It is a well known fact that the cotton plant varies in habit of growth. Sometimes the plant grows six feet high, but does not produce any more cotton than a plant growing one or two feet high. The character of the soil appears to have a good deal to do with this kind of growth, and in some cases the use of acid phosphate as a fertilizer has been found to promote the fruiting of the cotton, and the production of lint on land which shows a tendency to produce a large stalk and a small crop of lint.

Table 4—Pounds Stalk, Leaves, Bolls and Burs Produced per Acre.

	Stalk	Leaves	Bolls	Burs	Seed Cotton
Mebane, Beeville	1330	460	96	460	1170
Mebane, Temple	1065	1235	623	548	804
Rowden, Beeville	1090	384	37	604	1049
Mebane, Troup	1664	962	1673	190	730
Long Staple, Nacogdoches	1443	470	486	627	550
Mebane, Nacogdoches	1372	682	290	674	1113
Rowden, Denton	1513	1220	83	175	623
Mebane (Local), Denton	2126	2077	296	192	967
Crenshaw, Troup	2250	1690	1558	389	750
Mortgage Lifter, Temple	1043	543	57	558	636
Rowden, Lubbock	490	662	662	.....	169
Mebane, Lubbock	446	741	310	.....	389
Unknown, College Station	988	528	177	184	442

In Table 5 it is seen that from 311 to 899 pounds of stalk accompany 300 pounds seed cotton, with an average of 588 pounds. The

quantity of leaves varies from 109 to 1175 pounds, with an average of 446 pounds. The quantity of bolls varies from 9 to 1175 pounds, with an average of 313 pounds. Evidently a larger yield of cotton would have been produced with more favorable seasonal conditions. The burs vary from zero to 263 pounds, with an average of 162 pounds.

Table 5—Pounds Stalk, etc., per 300 pounds Seed Cotton.

	Stalk	Leaves	Bolls	Burs	Seed Cotton	Seed Cotton Per Acre
Mebane, Beeville	341	118	247	118	300	1170
Rowden, Beeville	312	1000	10	173	300	1049
Mebane, Nacogdoches	370	184	76	181	300	1113
Mebane, Temple	397	461	233	205	300	804
Mebane, Denton	670	645	92	60	300	967
Mebane, Troup	684	395	688	79	300	730
Crenshaw, Troup	900	676	623	156	300	750
Long Staple, Nacogdoches	787	257	267	342	300	550
Rowden, Denton	723	588	40	85	300	623
Mortgage Lifter, Troup	900	676	623	156	300	636
Rowden, Lubbock	870	1176	1176	.....	300	169
Mebane, Lubbock	344	572	240	.....	300	389
Unknown, College Station	671	359	121	125	300	442
Average	588	446	313	162	300	.....

Table 6—Fertilizer constituents in a crop of Cotton yielding 100 pounds of Lint from "The Cotton Plant."

(Pounds per acre.)

	Nitrogen	Phosphoric Acid	Potash	Lime	Magnesia
Roots (83 pounds)	0.76	0.43	1.06	0.53	0.34
Stems (219 pounds)	3.20	1.29	3.09	2.12	.92
Leaves (192 pounds)	6.16	2.28	3.46	8.52	1.67
Bolls (135 pounds)	3.43	1.30	2.44	.69	.54
Seed (218 pounds)	6.82	2.77	2.55	.55	1.20
Lint (100 pounds)	.34	.10	.46	.19	.08
Total crop (847 pounds)	20.71	8.17	13.06	12.60	4.75

The averages here given are more than double those given in "The Cotton Plant" (Table 6). Texas cotton apparently grows larger than the plants discussed in "The Cotton Plant." In some cases, however, larger yields of cotton would have been produced under more favorable seasonal conditions, thus decreasing the proportion of leaves, stalk, etc., to seed cotton. This is notably the case at Lubbock. Where good yields were secured, with Mebane variety at Beeville and Nacogdoches, and with Rowden at Beeville, the amount of stalk is about 350 pounds; of leaves, 150 pounds; of hulls, 50 pounds, and of burs, 160 pounds per 300 pounds seed cotton. These figures come much closer to the average given in "The Cotton Plant." The yields thus depend upon conditions other than the supply of plant food, and at the same time there may be enough plant food taken up to supply much larger yields than those actually made.

PLANT FOOD REQUIRED.

Table 7 shows the quantity of phosphoric acid, potash, nitrogen, silica, lime and magnesia, estimated to be taken up from the soil by the different cotton crops, and also the average of each. These results are worked out in Table 8. An allowance is made for the cotton actually produced and picked out on these different spots, it being assumed that it has the average composition. Some of the products were not completely analyzed. Where such was the case the average composition was used. This correction is made in the table.

Table 7—Pounds Plant Food Removed per Acre for the Crop Given.

	Yield Seed of Cotton per Acre	Phosphoric Acid	Potash	Nitrogen	Silica	Lime	Magnesia
Mebane, Beeville	1170	13.9	36.8	57.2	11.4	57.6	21.0
Rowden, Beeville	1049	11.1	49.9	47.1	13.4	39.5	18.8
Mebane, Nacogdoches	1113	12.5	68.5	54.3	16.1	59.9	22.0
Mebane, Temple	804	13.7	72.7	73.2	16.3	142.4	36.5
Mebane, Denton	967	33.9	81.1	89.2	71.3	200.4	48.4
Mebane, Troup	720	26.7	59.7	89.6	31.1	79.2	33.4
Crenshaw, Troup	750	36.3	84.5	127.7	124.3	138.3	49.2
Long Staple, Nacogdoches	550	15.0	64.0	47.7	12.5	49.6	26.0
Rowden, Denton	623	14.6	49.4	63.6	14.3	84.8	28.7
Mortgage Lifter, Troup	636	8.9	41.8	44.3	8.3	68.1	16.4
Rowden, Lubbock	169	10.2	40.9	44.4	15.1	70.8	15.4
Mebane, Lubbock	389	10.6	38.9	46.0	11.8	58.0	14.4
Unknown, College Station	442	10.5	35.1	45.9	12.4	101.0	15.9
Average	714	17.1	56.2	63.8	22.9	88.4	26.6

Table 8—Minerals Removed from the Soil.

	Lbs. per acre	Phosphoric Acid		Potash		Nitrogen		Silica		Lime		Magnesia	
		Per Cent.	Lbs.	Per Cent.	Lbs.	Per Cent.	Lbs.	Per Cent.	Lbs.	Per Cent.	Lbs.	Per Cent.	Lbs.
Burns Long Staple, Nacogdoches, Texas, September 24.													
6670 Stalk	14.43	.19	2.7	1.09	15.7	.66	9.5	.16	2.3	1.12	16.2	.54	7.8
6671 Seed Cotton (550)	8.86	.71	6.3	1.03	9.1	2.22	19.7	.35	3.1	.37	3.3	.33	2.9
6672 Leaves	4.70	.37	1.7	2.03	9.5	1.95	9.2	.95	4.5	4.26	20.0	.80	3.7
6673 Burs	6.27	.15	1.0	3.20	20.1	.58	3.6	.22	1.4	.90	5.6	.43	2.7
6674 Bolls	4.86	.68	3.3	1.98	9.6	1.18	5.7	.25	1.2	.93	4.5	.58	2.9
Total			15.0		64.0		47.7		12.5		49.6		20.0
Mebane, Nacogdoches, Texas, September 24.													
6675 Stalk	13.72	.14	1.9	1.10	15.3	.65	8.9	.08	1.1	.72	9.9	.44	6.0
6676 Seed Cotton (660)	11.13	.47	5.2	1.06	11.8	2.22	24.7	.20	2.2	.36	4.0	.41	4.6
6677 Leaves	6.82	.42	2.9	1.69	11.5	1.88	12.8	1.15	7.8	5.18	35.3	1.09	7.4
6678 Burs	6.74	.19	1.3	3.81	25.6	.53	3.6	.61	4.1	1.51	10.2	.44	2.9
6679 Bolls	2.90	.43	1.2	1.48	4.3	1.48	4.3	.03	.9	.50	1.5	.38	1.1
Total			12.5		68.5		54.3		16.1		59.9		22.0
Rowden, Denton, October 1.													
6703 Stalk (4)	15.13	.21	3.2	.98	14.8	.89	13.5	.16	2.4	1.12	16.9	.54	8.2
6704 Leaves	12.20	.50	6.1	16.1	19.6	2.72	33.2	.69	8.4	5.11	62.3	1.40	17.1
6705 Burs	1.75	.22	.4	3.77	6.6	0.96	1.7	0.61	1.1	1.51	2.6	.44	.8
6706 Bolls	.83	.50	.4	1.65	1.4	1.72	1.4	.25	.2	.93	.7	.58	.5
6707 Seed Cotton (623)	6.23	.72	4.5	1.01	6.3	2.22	13.8	.35	2.2	.37	2.3	.33	2.1
Total			14.6		48.7		63.6		14.3		84.8		28.7
Mebane (Local), Denton, October 1.													
6708 Stalk (4)	21.26	.45	9.6	1.12	23.8	1.07	22.7	.16	3.4	1.12	23.8	.54	11.5
6709 Leaves	20.77	.66	13.7	1.60	33.2	2.71	56.2	.60	12.5	7.83	162.6	1.51	31.4
6710 Burs	1.92	.27	.5	4.48	8.6	1.03	1.9	.61	1.2	1.51	2.9	.44	.8
6711 Bolls	2.96	.77	2.3	1.91	5.6	2.01	5.9	.28	.8	2.55	7.5	.52	1.5
6712 Seed Cotton	9.67	.81	7.8	1.02	9.9	2.22	21.5	.35	3.4	.37	3.6	.33	3.2
Total			33.9		81.1		89.2		21.3		200.4		48.4

Table 8—Minerals Removed from the Soil—Continued.

	Lbs. per acre	Phosphoric Acid		Potash		Nitrogen		Silica		Lime		Magnesia	
		Per Cent.	Lbs.	Per Cent.	Lbs.	Per Cent.	Lbs.	Per Cent.	Lbs.	Per Cent.	Lbs.	Per Cent.	Lbs.
Mebane, Beeville, September 14, 1912.													
6631 Stalk (4)	13.30	.23	3.0	.47	6.2	1.15	15.3	.16	2.1	1.12	14.9	.54	7.2
6632 Burs	4.60	.13	6.0	3.83	17.6	.69	3.2	.61	2.8	1.51	6.9	.44	2.0
6634 Leaves	4.60	.32	1.5	2.02	9.3	2.27	10.4	.48	2.2	6.79	31.2	1.57	7.2
6635 Bolls	.96	.50	0.5	1.95	1.9	2.42	2.3	.18	.2	.31	.3	.73	.7
Seed Cotton	11.70	0.71	8.3	1.01	11.8	2.22	26.0	.35	4.1	.37	4.3	.33	3.9
Total			13.9		36.8		57.2		11.4		57.6		21.0
Mebane, Temple, September 19, 1912.													
6656 Stalk (4)	10.65	.18	1.9	1.07	11.4	1.06	11.3	.33	3.5	1.49	15.9	.75	8.0
6657 Burs	5.48	.10	.5	4.16	22.8	.89	4.9	.32	1.8	2.16	11.8	.56	3.1
6658 Seed Cotton (804)	1.81	.71	1.31	.70	1.3	2.22	4.0	.18	.3	.28	.5	.19	.3
6659 Leaves	12.35	.27	3.3	1.70	21.0	2.26	27.9	.56	6.9	8.59	106.1	1.57	19.4
6660 Green Bolls	6.23	.37	2.3	1.60	9.9	1.81	11.3	.25	1.6	.93	5.8	.58	3.6
Seed Cotton (804)	6.23	.71	4.4	1.01	6.2	2.22	13.8	.35	2.2	.37	2.3	.33	2.1
Total			13.7		72.7		73.2		16.3		142.4		36.5
Rowden, Beeville, September 14.													
6636 Stalk (4)	10.90	.13	1.4	1.13	12.3	.86	9.4	.16	1.7	1.12	12.2	.54	5.9
6637 Burs	6.04	.13	.8	3.32	20.0	.68	4.1	.34	2.1	1.61	9.7	.49	2.9
6639 Leaves	3.84	.34	1.3	1.66	6.3	2.55	9.7	1.61	6.2	6.68	25.7	1.58	6.1
6640 Bolls	.37	.60	.2	1.92	.7	1.88	.6	.72	.3	3.05	1.12	1.17	.4
Seed Cotton	10.49	.71	7.4	1.01	10.6	2.22	23.3	.35	3.1	.37	3.9	.33	3.5
Total			11.1		49.9		47.1		13.4		39.5		18.8
Mebane, Troup, September 16.													
6646 Stalk (4)	16.64	.14	2.3	1.11	18.5	.90	15.0	.04	.7	.96	16.0	.50	8.3
6647 Burs	1.90	.39	.7	3.43	6.5	.96	1.8	.58	1.1	1.14	2.2	.37	.7
6648 Seed Cotton (730)	4.99	1.07	5.3	1.01	5.0	2.22	11.1	.47	2.3	.28	1.4	.32	1.6
6649 Leaves	9.62	.43	4.1	.66	6.3	2.62	25.2	2.34	22.5	5.29	51.0	1.56	15.0
6650 Green Bolls	16.73	.76	12.7	1.26	21.1	1.88	31.4	.22	3.7	.46	7.7	.42	7.0
Seed Cotton	2.31	.71	1.6	1.01	2.3	2.22	5.1	.35	.8	.37	.9	.33	.8
Total			26.7		59.7		89.6		31.1		79.2		33.4

Crenshaw, Troup, September 16.													
6641 Stalk (4)	22.50	.29	6.5	1.03	23.2	1.42	31.9	.03	.7	.81	18.2	.38	8.6
6642 Burs	3.89	.44	1.71	2.83	11.0	.96	3.7	1.95	7.6	1.29	5.0	.45	1.8
6643 Seed Cotton (750)	7.56	1.09	8.2	1.18	8.9	2.22	16.8	.56	4.2	.56	4.2	.41	3.1
6644 Leaves	16.90	.44	7.4	1.11	18.8	2.67	45.1	6.22	105.1	6.05	102.2	1.63	27.5
6645 Bolls	15.58	0.80	12.5	1.45	22.6	1.94	30.2	.43	6.7	.56	8.7	.53	8.2
Total			36.3		84.5		127.7		124.3		138.3		49.2
Mortgage Lifter, Troup,													
6651 Stalk (4)	10.43	.19	2.0	.91	9.5	1.10	11.4	.17	1.8	1.29	13.5	.54	5.6
6652 Burs	5.58	.12	.7	3.23	18.0	.96	5.4	.28	1.6	1.93	10.8	.33	1.8
6653 Seed Cotton (636)	6.36	.71	4.5	1.01	6.4	2.22	14.1	.35	2.2	.37	2.4	.33	2.1
6654 Leaves	5.43	.28	1.5	1.27	6.9	2.24	12.2	.47	2.6	7.54	40.9	1.22	6.6
6655 Bolls	.57	.27	.2	1.80	1.0	2.07	1.2	.25	.1	.93	.5	.58	.3
Total			8.9		41.8		44.3		8.3		68.1		16.4
Rowden, Lubbock, September 18, 1912.													
6663 Stalk	4.90	.31	1.5	2.23	10.9	1.45	7.1	.16	.8	1.12	5.4	.54	2.6
6664 Bolls	6.62	.65	4.3	2.04	13.5	2.14	14.2	.05	.3	.81	5.4	.43	2.8
6665 Leaves	6.62	.49	3.2	2.24	14.8	2.92	19.3	2.03	13.4	8.97	59.3	1.42	9.4
Seed Cotton (169)	1.69	.71	1.2	1.01	1.7	2.22	3.8	.35	.6	.37	.6	.33	.6
Total			10.2		40.9		44.4		15.1		70.8		15.4
Mebane, Lubbock, September 18, 1912.													
6667 Stalk	4.46	.35	1.6	2.76	12.4	1.54	6.9	.23	1.0	1.44	6.4	.65	2.9
6668 Bolls	3.10	.67	2.1	2.32	7.2	2.64	8.2	.11	.3	.83	2.6	.43	1.3
6669 Leaves	7.41	.55	4.1	2.08	15.4	3.01	22.3	2.58	19.1	6.42	47.6	1.20	8.9
Seed Cotton	3.89	.71	2.8	1.01	3.9	2.22	8.6	.35	1.4	.37	1.4	.33	1.3
Total			10.6		38.9		46.0		11.8		58.0		14.4
Unknown, College Station, Oct. 26, 1909.													
3177 Stalk	9.88	.33	3.3	1.30	12.8	1.51	14.9	.16	1.6	1.12	11.1	.54	5.3
3180 Bolls	1.77	.43	.8	2.80	5.0	1.69	3.0	.25	.4	.93	1.6	.58	1.0
3179 Burs	1.84	.69	1.3	2.00	3.7	2.30	4.2	.61	1.1	1.51	2.8	.44	.8
3178 Leaves	5.28	.38	2.0	1.72	9.1	2.65	14.0	1.47	7.8	6.42	33.9	1.38	7.3
Seed Cotton	4.42	.71	3.1	1.01	4.5	2.22	9.8	.35	1.5	.37	1.6	.33	1.5
Total			10.5		35.1		45.9		12.4		51.0		159.

The examination of the table shows quite a decided difference in the amount of plant food withdrawn per acre by the different crops. The amount of phosphoric acid varies from 8.9 to 36.3 pounds, with an average of 17.1. The amount of nitrogen varies from 44.3 to 127.7, with an average of 63.8 pounds. The amount of potash varies from 35.1 to 84.5, with an average of 55.2 pounds. The amount of lime varies from 39.5 to 200.4, with an average of 88.4 pounds. The amount of magnesia varies from 14.4 to 48.4, with an average of 26.6 pounds.

Table 9—Pounds Removed per Three Hundred Pounds Seed Cotton.

	Yield of Seed Cotton per Acre	Phosphoric Acid	Potash	Nitrogen	Silica	Lime	Magnesia
Mebane, Beeville	1170	3.6	9.4	14.6	2.9	14.7	5.3
Rowden, Beeville	1049	3.1	14.2	25.6	8.8	19.7	9.5
Mebane, Nacogdoches	1113	3.3	18.4	14.6	4.3	16.1	5.9
Mebane, Temple	804	5.1	27.1	27.2	6.0	53.1	13.6
Mebane, Denton	969	10.5	25.1	27.8	3.5	6.25	15.1
Mebane, Troup	730	10.9	24.5	36.7	12.7	3.3	1.3
Crenshaw, Troup	750	14.5	33.7	51.0	49.7	55.3	19.6
Long Staple, Nacogdoches	550	8.1	34.9	26.0	6.8	27.0	14.1
Rowden, Denton	623	7.0	23.6	30.6	6.8	40.8	13.8
Mortgage Lifter, Troup	636	4.1	19.7	20.8	3.9	32.1	7.7
Rowden, Lubbock	769	18.1	72.6	78.8	26.8	12.5	27.3
Mebane, Lubbock	389	8.1	29.9	35.4	9.0	45.2	11.1
Unknown, College Station	442	7.1	23.9	31.1	8.4	68.5	10.7
Average	723	7.9	29.0	32.3	11.5	34.7	11.9

The yields also vary in the results given in Table 7. The amount of plant food taken for each 300 pounds of seed cotton produced is given in Table 9. This is calculated from the previous results. There is still a decided variation in the plant food which is consumed.

The phosphoric acid used per 300 pounds seed cotton varies from 3.1 to 18.1 pounds, with an average of 8.0 pounds. This is nearly the same average as that given in "The Cotton Plant." The potash varies from 9.4 to 72.6 pounds, with an average of 27.0, which is twice the average given in "The Cotton Plant." The nitrogen varies from 14.6 to 78.8, with an average of 32.3, which is 60 per cent. more than the average given in "The Cotton Plant."

The results are arranged in Table 9 according to the yields of seed cotton. With yields of from 1000 to 1200 pounds per acre, only about 5 pounds phosphoric acid, from 9 to 18 pounds potash, and from 15 to 25 pounds nitrogen, are used per 300 pounds of seed cotton.

When less than 1000 pounds seed cotton is produced the amount of mineral taken from the soil is proportionately greater. The plant is larger in proportion to the yield and may form bolls which do not produce cotton. An excess of potash may be taken up, as is the case with other plants. In view of these facts more weight should be given to the minerals taken up when the high yields are secured. The probable needs of cotton per 300 pounds seed cotton, or 100 pounds of lint, are, therefore, estimated as follows:

Phosphoric acid 7.0
Nitrogen 25.0
Potash 15.0

The draft on the soil is not in direct proportion to the size of the crop, but is somewhat more with small crops and somewhat less with large crops, particularly in Texas. Thus seasonal conditions may cut short the crop though the plant food be abundant, and good conditions may cause a good utilization of the plant food and produce a good crop, with a moderate consumption of minerals.

FEEDING COMPOSITION.

Table 10 shows the feeding composition. The cotton leaves are quite high in protein and fat, and low in fiber. There are no digestion experiments on cotton leaves. Cotton leaves should make a good feed. Judged from the chemical composition the leaves should have a better feeding value than alfalfa hay, and as there are from 400 to 2000 pounds of dry leaves per acre, they must have some feeding value per acre of cotton. The cotton bolls should also have a good feeding value. These bolls contain immature seed, and some cotton lint and are not the same as the empty burs. The composition is quite variable, probably depending upon the degree of maturity of the bolls when the samples were collected. The feeding value is not nearly as high as that of the leaves.

Table 10—Feeding Composition Cotton Leaves.

	Protein	Ether Extract	Crude Fibre	Nitrogen-free Extract	Water	Ash
3178 Cotton Leaves	16.58	12.41	12.79	31.77	7.37	19.08
6634 Mebane Triumph	14.22	11.80	10.14	39.28	6.22	18.54
6644 Crenshaw	16.69	6.51	12.05	36.64	7.61	20.50
6649 Crenshaw	16.40	7.54	10.82	43.57	7.07	14.60
6654 Mortgage Lifter	14.01	9.62	9.08	42.74	7.34	17.21
6659 Mebane	14.04	6.88	9.31	41.63	7.66	20.48
6669 Mebane	18.80	4.52	9.96	43.19	5.62	17.91
6672 Burns Long Staple	12.22	9.20	7.23	53.92	5.64	11.79
6677 Mebane	11.77	7.95	10.20	50.40	5.66	14.02
6704 Rowden	16.99	3.35	9.65	44.65	7.87	17.41
6709 Local (Mebane)	16.94	4.66	9.13	44.75	7.03	17.49
6665 Rowden	18.24	4.84	8.80	40.83	6.33	20.96
Average	15.58	7.44	9.93	42.78	6.78	17.49

Table 10—Cotton Bolls.

	Protein	Ether Extract	Crude Fibre	Nitrogen-free Extract	Water	Ash
3179 Cotton Bolls	14.41	3.74	23.94	43.75	8.83	5.33
6655 Mebane Triumph	15.12	2.32	14.14	54.57	6.91	6.94
3674 Long Staple Cotton	7.35	3.05	42.49	35.08	6.34	5.69
6679 Mebane Cotton	7.58	4.07	43.99	32.24	8.85	3.27
Average	11.11	3.30	31.14	41.41	7.73	5.31

Table 10—Cotton Burs.

	Protein	Ether Extract	Crude Fibre	Nitrogen-free Extract	Water	Ash
3179 Cotton Burs	10.61	3.31	29.99	39.48	8.93	7.68
6637 Rowden	4.25	1.54	42.84	45.44	7.62	8.31
6667 Mebane	9.92	.78	37.64	37.03	7.76	6.87
6673 Burns Long Staple	3.62	.96	36.13	44.70	8.49	6.10
6678 Mebane	3.34	1.38	34.15	44.09	9.80	7.24
Average	6.35	1.59	34.15	42.15	8.52	7.24

Table 10—Cotton Stalk.

	Protein	Ether Extract	Crude Fibre	Nitrogen-free Extract	Water	Ash
3177 Cotton Stalk	9.45	.78	30.84	46.31	7.44	5.18
6636 Rowden	5.36	.78	48.18	34.38	6.99	4.31
6641 Crenshaw	8.90	.62	44.03	35.81	7.36	3.28
6646 Triumph	5.64	.86	43.68	39.33	6.85	3.64
6651 Mortgage Lifter	6.86	.58	33.16	46.94	7.55	4.91
6656 Mebane	6.60	.76	49.82	29.49	7.79	5.54
6675 Mebane	4.07	.73	38.81	45.65	7.50	3.24
Average	6.69	.73	41.22	39.70	7.36	4.30

The cotton burs have a low feeding value, about 55 per cent. of that of alfalfa hay and perhaps a little better than cotton seed hulls. A digestion experiment with cotton burs is given in Bulletin No. 245. Cotton burs are often found outside of gins, where they have been blown from the cotton in ginning. They are eaten by cattle, have some feeding value, and there is no reason why they should not be utilized as a coarse feed in the vicinity of the gin. They contain some seed and this makes the value somewhat greater than that given above.

The cotton stalks are low in protein and fat, and high in fiber. They are also tough and difficult to chew. The feeding value is low, but they could be used as roughage, when they will probably be only partly eaten.

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SUMMARY AND CONCLUSIONS.

Analyses of the cotton plant were made on four plants of average size selected by the superintendents of the various substations.

The cotton plant varies in habit of growth. In some cases a large growth of leaves and stalk is accompanied by a small yield of cotton, while in other cases a comparatively small growth is accompanied by a fair yield of cotton.

The average amounts which accompany 300 pounds of seed cotton are 588 pounds of stalk, 446 pounds of leaves, 313 pounds of bolls, and 162 pounds of burs. There are large variations in the individual cases. These averages are more than double those given in "The Cotton Plant" as found in previous studies. Larger yields of cotton would have been produced with practically the same amount of parts of the plant, if seasonal conditions had been more favorable.

Where yields of 1000 to 1200 pounds seed cotton per acre are produced, the amount of stalk per 300 pounds of seed cotton is about 350 pounds; of leaves, 150 pounds; of bolls, 50 pounds, and of burs, 160 pounds. These figures correspond more closely to the averages given in "The Cotton Plant."

The phosphoric acid used per 300 pounds seed cotton varies from 3.1 to 18.1 pounds, with an average of 8.0; the potash from 9.4 to 72.6, with an average of 27.0 pounds; the nitrogen from 14.6 to 78.8, with an average of 32.3 pounds.

With yields of from 1000 to 1200 pounds of seed cotton, about 5 pounds of phosphoric acid, 9 to 18 pounds of potash, and 15 to 25 pounds of nitrogen are used per 300 pounds of cotton seed.

When less than 1000 pounds seed cotton per acre is produced, the amount of mineral taken from the soil per 300 pounds seed cotton is proportionately greater. The plant is larger in proportion to the yield, and may form bolls which do not produce cotton.

An excess of potash may be taken up by the cotton plant.

The probable needs of cotton per 300 pounds seed cotton or 100 pounds lint, are estimated to be 7 pounds phosphoric acid, 25 pounds nitrogen, and 15 pounds potash.

The draft on the soil is not in direct proportion to the size of the crop, but is somewhat larger for small crops and somewhat less for large crops.

Cotton leaves are moderately high in protein, high in ether extract, moderate in crude fiber, and should have a good feeding value.

Empty burs, which are found around gins, contain some seed, and have a feeding value probably a little higher than that of cotton seed hulls.