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Sagrain in the Yazoo-Mississippi Delta, Delta Experiment Station, Stoneville, Mississippi

Roy G. Kuykendall

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SAGRAIN

In The

YAZOO-MISSISSIPPI DELTA

Delta Experiment Station

Stoneville, Mississippi

By

Roy Kuykendall

Second and third year strains in the early sagrain breeding work.

MISSISSIPPI AGRICULTURAL EXPERIMENT STATIONS

State College, Mississippi

J. R. RICKS, Director

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SAGRAIN IN THE YAZOO-MISSISSIPPI DELTA

Roy Kuykendall *

INTRODUCTION

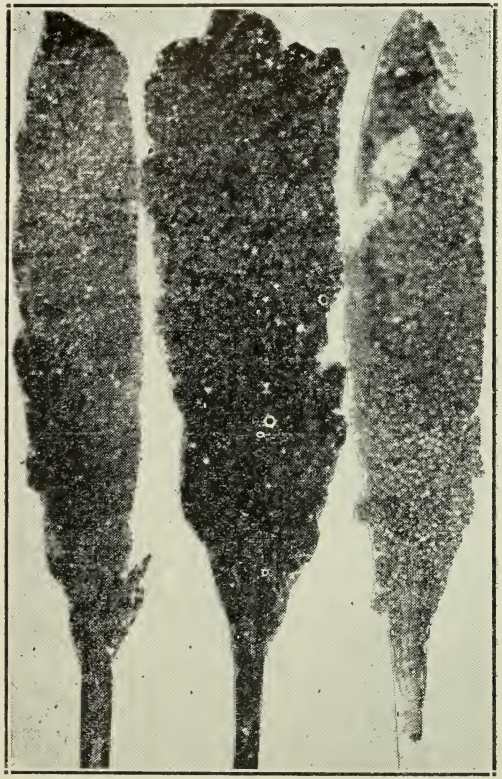
Sagrain is one of the major feed crops in the Yazoo-Mississippi Delta. It is adapted to most all soil types throughout the Delta area. It is similar to sorghum in that it is in the sorghum family, and thrives under the same adverse conditions. It produces more grain than ordinary sorghum and is a safer feed crop than corn on the soils that are usually used for corn in the Yazoo-Mississippi Delta. It responds very readily to good soils, fertilizers and good cultivation, but will withstand much more neglect and adverse conditions than the other common feed crops of this area.

HISTORY AND DESCRIPTION

In 1917 Mr. W. T. Allen, Clarksdale, Mississippi, planted a field of sweet sorghum to cut and feed green to his livestock. In this field there was a mixture of regular sorghum and some low growing, heavy grain-producing stalks.

Long and short type plants in the early sagrain breeding work.

*Acknowledgements: The Author wishes to express his appreciation to Mr. W. E. Ayres, under whose direction this work was carried out; to Mr. H. A. York, who is responsible for the present selected strain of sagrain; and to Mr. J. B. Turner who conducted the 1927 tests.



Grain sorghum head types. Left, darso; center, sagrain; right, schrock.

One sagrain stool showing number of heads produced when stand is poor.

Dr. W. J. Lacy, Lyon, Mississippi, noticed these peculiar, short stalks, investigated and found out that it was not an intended mixture of sweet sorghum and one of the kaffirs which it resembled. Both types were sweet. Dr. Lacy asked and was granted the privilege of cutting a seed supply. He selected the choicest heads and most uniform stalks over the entire field. He continued to select his seed each year in this manner.

In 1923 the Delta Station obtained from Dr. Lacy some selected heads from this low growing, heavy grain producing sorghum. These heads were planted in a plant to row test in 1924. There was considerable variation in plant type and grain yield, but all strains had sweet stalks which were rather stocky and the grain yield extremely high. This seed selecting and increasing was continued until the present strain, called sagrain, was developed.

It is the opinion of some that sagrain and schrock are identical. They are similar in that both, presumably, are hybrids of some sweet sorghum and a grain sorghum. It is possible to select many different plant types from either. Sagrain could be a new hybrid or a new strain of schrock resulting from several years of careful selection. It was named "sagrain" (to indicate saccharine, grain sorghum) because of its evident kinship to both grain and saccharine sorghum.

A high grain yielding field of sagrain.

TESTS AND METHODS

Since 1923, various types of experiments with sagrain have been conducted at this station. These investigations have consisted of the following tests:

1. Dates of seeding.

2. Spacing.
   a. Sagrain alone.
   b. Sagrain and soybeans.

3. Fertility.

A. Direct applications of commercial fertilizers.
   a. Sources of commercial nitrogen.
   b. Rates of applying ammonium sulphate.
   c. Dates of applying ammonium sulphate.

B. Indirect applications of commercial fertilizers.
   a. Residual effect of "sources of nitrogen" applied to a preceding crop of oats.
   b. Residual effect of "rates of applying sodium nitrate" applied to a preceding crop of oats.
   c. Residual effect of "dates of applying sodium nitrate" applied to a preceding crop of oats.

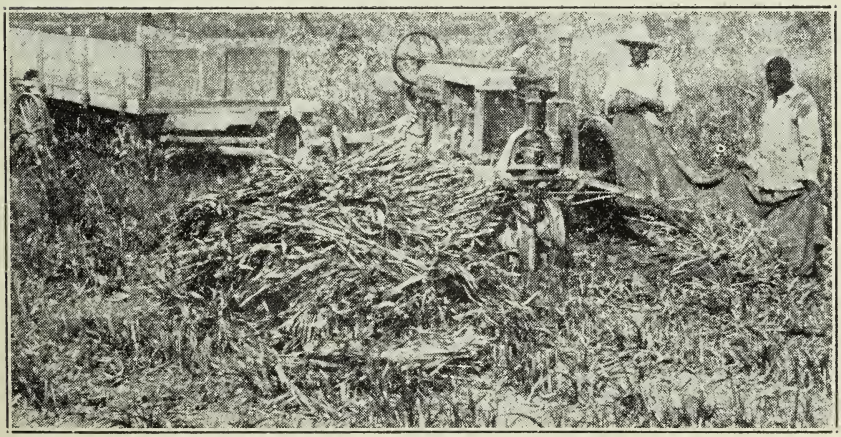
C. Residual effect of sagrain, corn and varieties of soybeans on the following crop of cotton.

4. Sagrain as a pasture crop.

5. Sagrain curing and winter storing in the open.

Harvesting sagrain with a corn binder.

Shocking sagrain on a Yazoo-Mississippi Delta plantation.



Removing sagrain heads with a tractor cut off saw in the fertilizer tests.

All plots consisted of six 1/108 of an acre rows and the four center rows were harvested with a corn binder from which to compute per acre yields. In most cases the sagrain was cut, bundled, shocked and cured in the field. The heads from each treatment were thrashed and the grain weighed separately. The cured stalks were weighed in the field.

In a few cases where the grain failed to mature the sagrain was cut, bundled and weighed green and representative samples taken to obtain the percentage dry weight then the total per acre dry weight computed from the dry weight percentage of the sample.

All tests were planted with a two row planter.

There were seven replications of each date of seeding. The order of the date of seeding was reversed each year. Soybeans were interplanted in the row with the sagrain when the sagrain was planted. This test was conducted on a Sharkey sandy loam soil.

The sagrain alone and sagrain and soybeans spacing tests were identical except the latter had soybeans planted in alternate hills. The sagrain was planted with a two row planter in hills 13 inches apart and thinned according to the plan. The soybeans were allowed to stand as they came up.

In 1928 and 1929 ammonium sulphate was applied to all plots in the spacing tests at the rate of 200 pounds per acre. In 1930 the rate was changed to 150 pounds per acre. There were two replications in each test. Both tests were conducted on a Sharkey clay loam soil.

The fertility tests were divided into two classes, namely: Those in which the fertilizers were applied directly to the sagrain crop and those in which the fertilizers were applied to a preceding crop of oats.

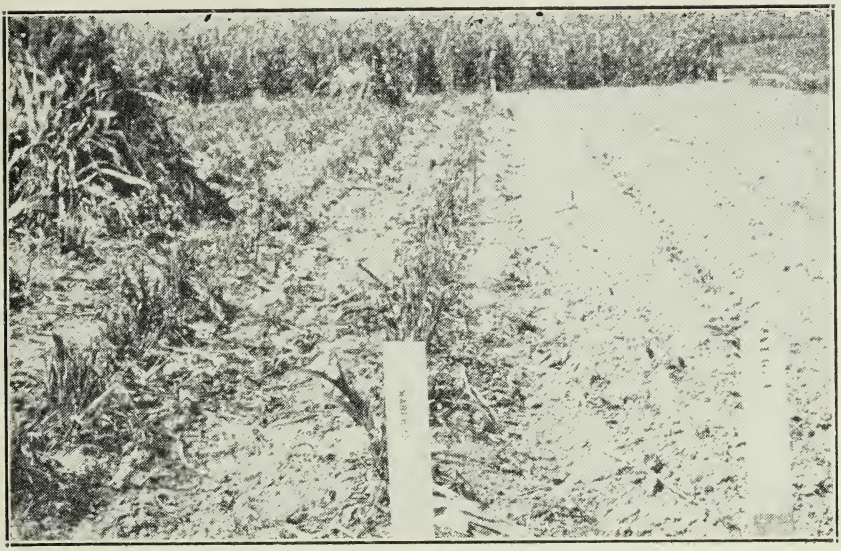
In the direct applications tests the fertilizers were weighed for each row separately and applied by hand. Each fertilizer was applied before planting except in the "dates of application" where applications were made as indicated. These tests were conducted on a Sharkey clay loam soil. In the tests where the fertilizers were applied to the preceding crop of oats the correct amount of fertilizer for each plot, 1/20 of an acre, was weighed and applied on the oats in the spring except where otherwise stated. Thirty pounds of nitrogen per acre were used everywhere except in the rates of application or where otherwise stated. These tests were conducted on a Sharkey loam soil. All treatments were replicated from three to five times.

The sagrain, corn and varieties of soybeans were planted at the same time and fertilized alike. The per acre yield was calculated on the total grain, stover and soybeans. The test was rotated with sagrain, corn and varieties of soybeans one year and cotton the next. The test was so arranged that both cotton and the other crops were grown every year. The cotton was not otherwise fertilized. These tests were conducted on a Sharkey clay loam soil.

EXPERIMENTAL RESULTS

DATES OF SEEDING

The object of this test was to determine just how late sagrain could be planted and produce a crop, and the best average date of seeding.



Left—Sagrain planted March 15; cut and shocked August 15.

Right—Sagrain planted August 1 and not up August 15 because of the lack of moisture.

Sagrain planted March 15 and cut August 15. Second growth matured heads by November 1, the date of the photograph.

TABLE I—Dates of Seeding Sagrain*

Seeding Date	1929	1930	1931	1932	1933	Av. yield 1929-33
Yields—bushels of grain per acre						
March 15	22.9	4.0	16.2	38.1	21.1	20.5
April 1	24.5	9.3	32.1	30.1	4.8	20.2
April 15	24.7	8.9	24.5	24.5	29.2	22.4
May 1	17.2	4.1	20.6	16.8	9.5	13.6
May 15	---	6.7	19.3	---	---	5.2
June 1	---	12.8	---	---	---	---
June 15	---	18.3	---	---	---	---
July 1	---	14.3	---	Failed to mature grain		---
July 15	---	1.9	---	---	---	---
August 1	---	.2	---	---	---	---
Yields—pounds of heads and stover per acre						
March 15	8173	4701	8451	5666	4672	6333
April 1	8234	5610	8281	7206	4258	6718
April 15	9596	6027	7296	6335	4459	6743
May 1	13490	8606	7758	6322	3871	8009
May 15	11333	9980	7796	4688	6937	8147
June 1	8878	11773	Failed	5671	3920	6048
June 15	7566	7713	to	7249	5616	5629
July 1	7064	6026	mature	6340	5505	4987
July 15	Failed	4193	heads	Failed	9410	2720
August 1	to head	817		to head	7017	1567

* All dates of planting produced a fair growth of stalks but most of the late ones failed to mature seed and were not harvested and weighed every year.

According to the results obtained by Delta planters sagrain will produce and mature fair crops of stover and grain planted any date between March 15 and August 1, however in this test on light loam land it failed to yield mature grain three years out of five when planted later than May 1, and failed four years out of five when planted later than May 15. The results as given in Table I show that the highest grain yields were produced from plantings made April 15 while the plantings of May 1 to 15 produced the greatest yields of forage.

SPACING

As sagrain was a new crop in the Delta, information was needed as to how thick to leave the stand to produce maximum yields. Spacing tests with sagrain alone and in combination with alternate hills of soybeans were begun in 1928. The results of these tests are given in Table II and III

TABLE II—Sagrain Spacing—Sagrain Alone

Plants per hill in 13-inch spacings	1928	1929	1930	1931	1932	Averages Yield	Averages Increase
Yields—bushels of grain per acre							
5 Plants per hill ____	31.3	27.5	24.2	11.5	33.7	25.6	
2 Plants per hill ____	28.4	29.5	22.9	9.2	33.7	24.7	—0.9
3 Plants per hill ____	21.8	29.2	25.2	9.1	33.6	23.8	—1.8
4 Plants per hill ____	25.8	34.3	24.4	9.1	36.2	26.0	0.4
5 Plants per hill ____	31.3	27.5	24.2	11.5	33.7	25.6	
6 Plants per hill ____	23.4	32.8	24.3	13.6	33.7	25.6	0.0
7 Plants per hill ____	26.1	30.5	23.3	10.1	34.7	24.9	—0.7
Blocked all left _____	28.7	29.3	20.7	11.2	32.2	24.4	—1.2
5 Plants per hill ____	31.3	27.5	24.2	11.5	33.7	25.6	
Yields—pounds of heads and stover per acre							
5 Plants per hill ____	7607	4914	10330	8617	8122	7918	
2 Plants per hill ____	6740	4680	8725	6118	7259	6704	—1214
3 Plants per hill ____	7357	5470	9888	7420	7501	7527	— 391
4 Plants per hill ____	7017	6265	10020	8475	7810	7917	— 1
5 Plants per hill ____	7607	4914	10330	8617	8122	7918	
6 Plants per hill ____	7801	4388	10956	8536	7802	7897	— 21
7 Plants per hill ____	6736	5645	9264	8158	8896	7740	— 178
Blocked all left _____	7947	5441	10256	8668	10416	8546	628
5 Plants per hill ____	7607	4914	10330	8617	8122	7918	

2 sagrain plants per hill; soybeans predominate.

3 sagrain plants per hill; soybeans predominate

7 sagrain plants per hill; sagrain predominates

TABLE III—Sagrain Spacing With Alternate Hills

George Washington Soybeans

Plants per hill in 26 inch spacings	1928	1929	1930	1931	1932	Averages	
						Yield	Increase
Yields—bushels of grain per acre							
5 Plants per hill ____	19.2	20.5	5.4	7.7	21.3	14.8	
2 Plants per hill ____	13.7	21.8	5.0	5.4	15.0	12.2	—2.6
3 Plants per hill ____	13.7	20.6	4.4	6.0	16.1	12.2	—2.6
4 Plants per hill ____	14.9	22.9	6.1	7.6	20.4	14.4	—0.4
5 Plants per hill ____	19.2	20.5	5.4	7.7	21.3	14.8	
6 Plants per hill ____	21.6	24.2	6.2	7.8	22.3	16.4	1.6
7 Plants per hill ____	24.4	25.1	4.4	7.2	21.0	16.4	1.6
Blocked all left _____	28.7	21.2	3.0	11.0	24.1	17.6	2.8
5 Plants per hill ____	19.2	20.5	5.4	7.7	21.3	14.8	
Yields—pounds of heads and stover per acre							
5 Plants per hill ____	7696	4037	12461	4974	5362	6906	
2 Plants per hill ____	7035	5587	11711	4364	4637	6667	—239
3 Plants per hill ____	6682	5119	12101	5098	4986	6797	—109
4 Plants per hill ____	7474	5616	13632	4771	5112	7321	415
5 Plants per hill ____	7696	4037	12461	4974	5362	6906	
6 Plants per hill ____	7357	6055	12826	5266	5150	7331	425
7 Plants per hill ____	8624	6523	12948	5208	5236	7708	802
Blocked all left ____	10220	4914	11570	5815	5098	7523	617
5 Plants per hill ____	7696	4037	12461	4974	5362	6906	

The 4 to 6 plants per hill spacings produced the highest average yields of grain and the 5 or more plants per hill produced the highest stover yields in the sagrain alone spacing test. Six or more plants per hill produced the highest average yields of grain and stover in the sagrain and soybeans spacing test. See Tables II and III.

Table III indicates that the grain yield of sagrain was reduced considerably when soybeans were planted in alternate hills with sagrain even though the crops were continued on the same land for a period of five years and fertilized with commercial nitrogen. However, the total crop was removed from the land, and the soybean grain was not harvested separately and added to the grain yield of sagrain. The quality of forage was also materially improved by the soybeans.

FERTILITY

Since sagrain was so well adapted to the Yazoo-Mississippi Delta as a feed crop and produced such high yields of forage, thereby removing from the soil large amounts of plant food, it was necessary to work out some system of soil maintenance in connection with sagrain production. Various types of soil fertility investigations have been conducted on this Station since 1927.

Direct Applications of Commercial Fertilizers

Sources of Nitrogen

The object of this test was to determine which source of commercial nitrogen would produce the highest yields of grain and forage. Tabe IV shows the results.

TABLE IV—Commercial Sources of Nitrogen for Sagrain Annual and Average Yields and Increases 30 Pounds of Nitrogen per Acre

Sources of Nitrogen	1927	1928	1929	1930	1931	1932	1933 *	1934	1935	Averag
Yields—bushels of grain per acre										
Check no fertilizer_	60.6	33.5	14.8	16.9	3.0	9.0	___	3.4	3.9	16
Calurea _____	66.8	51.6	27.2	25.1	10.0	22.2	___	16.9	12.9	25
Calcium nitrate __	71.4	41.3	28.5	21.2	14.1	24.5	___	17.0	14.7	25
Sodium nitrate ___	73.5	49.7	27.9	23.0	13.7	25.3	___	12.0	7.2	25
Check no fertilizer_	60.6	33.5	14.8	16.9	3.0	9.0	___	3.4	3.9	16
Ammonium sulphate	68.3	59.6	32.7	22.9	8.4	20.5	___	15.3	9.8	26
Leunasalpeter ____	71.5	55.0	27.9	22.0	15.6	22.5	___	13.7	10.3	26
Cyanamid _____	66.1	43.9	25.7	19.0	15.9	16.0	___	14.7	9.0	23
Check no fertilizer_	60.6	33.5	14.8	16.9	3.0	9.0	___	3.4	3.9	16
Increases—bushels of grain per acre										
Calurea _____	6.3	18.0	12.4	8.2	7.0	13.2	___	13.4	9.0	9
Calcium nitrate ___	10.9	7.8	13.7	4.3	11.1	15.5	___	13.5	10.8	9
Sodium nitrate ___	12.9	16.2	13.1	6.2	10.8	16.3	___	8.6	3.3	9
Ammonium sulphate	7.7	26.4	17.9	6.0	5.4	11.5	___	11.9	5.9	10
Leunasalpeter ____	10.9	21.5	13.1	5.1	12.6	13.5	___	10.3	6.4	10
Cyanamid _____	5.5	10.3	10.8	2.1	13.0	6.9	___	11.3	5.1	7
Yields—pounds of heads and stover per acre										
Check no fertilizer	11899	6616	3666	7353	5595	4851	4983	4283	3519	58
Calurea _____	12618	8622	5558	8824	6935	6435	6232	6697	4272	73
Calcium nitrate _	12987	8199	5694	8665	6847	6422	6118	6657	4652	73
Sodium nitrate __	12456	8821	4641	8597	7137	6271	5264	5404	4659	70
Check no fertilizer	11899	6616	3666	7353	5595	4851	4983	4283	3519	58
Ammonium sul. _	11314	8110	5460	9506	6872	6514	6183	6135	4425	71
Leunasalpeter ___	12456	9956	5324	9623	6979	6284	6152	6214	4264	74
Cyanamid _____	12148	8897	5577	8393	6468	5851	6363	6138	3704	70
Check no fertilizer	11899	6616	3666	7353	5595	4851	4983	4283	3519	58
Increases—pounds of heads and stover per acre										
Calurea _____	718	2006	1892	1471	1340	1584	1249	2414	753	14
Calcium nitrate __	1087	1583	2028	1312	1252	1572	1135	2374	1133	1
Sodium nitrate __	557	2205	975	1244	1542	1420	281	1121	1140	1
Ammonium sul.__	—586	1494	1794	2153	1277	1663	120	1852	906	1
Leunasalpeter ____	556	3340	1658	2270	1384	1434	1169	1931	745	1
Cyanamid _____	248	2281	1911	1040	873	1001	1380	1855	185	1

* Failed to mature grain because of late germination and dry weather.

In 1927 the unfertilized plots produced approximately 61 bushels of grain per acre. The yields of these same plots decreased rapidly to approximately 4 bushels per acre in 1935. The fertilized plots also decreased gradually from 60 to 70 bushels of grain per acre in 1927 to 7 to 14 bushels in 1935. The stover yields decreased from around 11,900 and above 12,000 pounds in 1927 to 3500 and 4500 pounds per acre in 1935 for the unfertilized and fertilized plots respectively.

As a nine year average all the sources of nitrogen increased the yield 7 to 10 bushels of grain per acre or 45 to 65 percent. The average increase in stover was from 1165 to 1497 pounds per acre or 20 to 27 percent. (See Table IV)

Rates of Applying Ammonium Sulphate

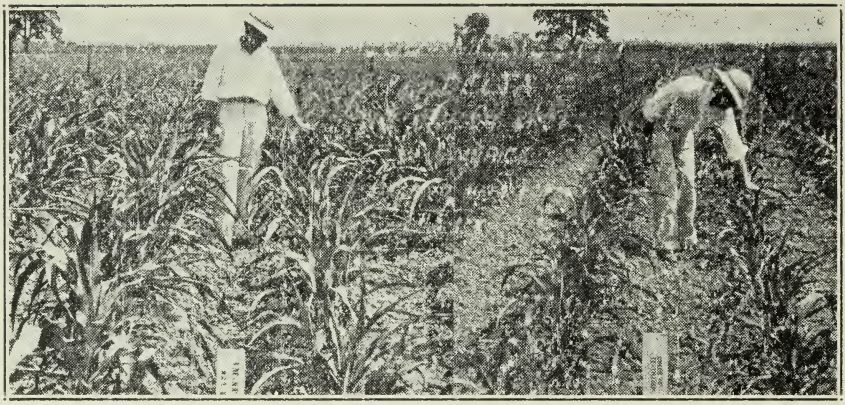
The object of this test was to determine the most economical rate of applying nitrogen on sagrain, and the rate of increase of soil acidity from the use of ammonium sulphate measured in terms of crop yields as the sorghums will not usually grow successfully on very acid soils. Table V shows the results.

TABLE V—Rates of Applying Ammonium Sulphate on Sagrain Annual and Average Yields and Increases

Rate Per Acre	1927	1928	1929	1930	1931	1932	1933 *	1934	1935	Average
Yields—bushels of grain per acre										
Check no fertilizer	55.7	15.3	9.3	8.8	3.4	4.8	---	1.3	1.8	11.2
7 lbs. per acre	56.3	23.5	10.8	9.9	5.6	10.5	---	3.6	6.5	14.1
13 lbs. per acre	64.5	33.2	14.1	13.6	8.0	14.4	---	10.0	11.6	18.8
20 lbs. per acre	65.6	36.2	15.9	14.7	10.0	23.2	---	11.6	14.6	21.3
Check no fertilizer	55.7	15.3	9.3	8.8	3.4	4.8	---	1.3	1.8	11.2
18 lbs. per acre	69.4	41.1	15.2	14.2	10.0	21.8	---	12.7	5.4	21.1
25 lbs. per acre	76.4	43.3	18.1	16.5	12.8	26.3	---	15.6	11.3	24.5
33 lbs. per acre	79.8	45.4	17.5	16.3	17.9	25.9	---	14.4	9.9	25.2
Check no fertilizer	55.7	15.3	9.3	8.8	3.4	4.8	---	1.3	1.8	11.2
Increases—bushels of grain per acre										
7 lbs. per acre	0.6	8.2	1.5	1.1	2.2	5.7	---	2.3	4.7	2.9
13 lbs. per acre	8.8	17.9	4.8	4.8	4.6	9.6	---	8.7	9.8	7.6
20 lbs. per acre	9.9	20.9	6.6	5.9	6.6	18.4	---	10.3	12.8	10.1
18 lbs. per acre	13.7	25.8	5.9	5.4	6.6	17.0	---	11.4	3.6	9.9
25 lbs. per acre	20.7	28.0	8.8	7.7	9.4	21.5	---	14.3	9.5	13.3
33 lbs. per acre	24.1	30.1	8.2	7.5	14.5	21.1	---	13.1	8.1	14.0
Yields—pounds of heads and stover per acre										
Check no fertilizer	11362	5678	3130	5497	4894	4477	4515	3853	3735	5238
7 lbs. per acre	11587	6082	3900	6697	5926	5383	5432	5077	3393	5942
13 lbs. per acre	11612	6373	4029	6713	6700	5858	5768	5883	3808	6305
20 lbs. per acre	12605	6795	4534	7576	7009	6264	6063	6328	4579	6861
Check no fertilizer	11362	5678	3130	5497	4894	4477	4515	3853	3735	5238
18 lbs. per acre	12606	7329	4563	7217	6718	6745	6330	6459	4432	6933
25 lbs. per acre	12678	8632	5012	7771	6874	7217	6133	6323	4824	7274
33 lbs. per acre	13849	8076	5012	8430	7118	7338	6332	6308	4380	7427
Check no fertilizer	11362	5678	3130	5497	4894	4477	4515	3853	3735	5238
Increases—pounds of heads and stover per acre										
7 lbs. per acre	225	404	770	1200	1032	906	917	1224	—342	704
13 lbs. per acre	250	695	899	1216	1806	1381	1253	2030	73	1067
20 lbs. per acre	1243	1117	1404	2079	2115	1787	1548	2475	844	1623
18 lbs. per acre	1244	1651	1433	1721	1824	2268	1815	2606	697	1695
25 lbs. per acre	1316	2954	1882	2275	1980	2740	1618	2471	1089	2036
33 lbs. per acre	2487	2398	1882	2933	2224	2861	1817	2456	645	2189

* Failed to mature grain because of late germination and dry weather.

Table V indicates that the unfertilized plots decreased rapidly from a yield of approximately 56 bushels of grain per acre in 1927 to approximately 2 bushels in 1935 and the stover decreased from 11,362 to 3735 pounds per acre in the same years. The fertilized plots decreased also but the percent increase over the unfertilized plots increased considerably.



Left—225 pounds of ammonium sulphate per acre on sagrain.

Right—Unfertilized sagrain.

The nine year average increase runs from 26% for the lowest rate to 125% for the highest rate for grain production. The nine year average increases run from 13% for the lowest rate to 42% for the highest rate for stover production.

These results indicate that 150 pounds of ammonium sulphate per acre is probably the most economical rate of application for sagrain, and that ammonium sulphate has not increased the acidity of the soil to the extent of reducing the yields.

Dates of Applying Ammonium Sulphate

In 1927 a test was begun to determine the best time to apply nitrogen to sagrain to produce maximum yields. Ammonium sulphate was used. Results of this test are presented in Table VI.

TABLE VI—Dates of Applying Ammonium Sulphate 30 Pounds of Nitrogen per Acre

When Applied	1927	1928	1929	1930	1931	1932	Average Yield	Average Increase
Yields—bushels of grain per acre								
At planting	59.8	20.2	11.6	19.8	9.8	29.0	25.1	
12 Inches high	70.7	18.6	15.1	22.3	6.3	28.5	26.9	1.8
24 Inches high	60.9	25.0	8.9	17.1	5.2	22.0	23.2	—1.9
No fertilizer	60.0	14.5	6.1	15.1	1.8	6.3	17.3	—7.8
At planting	59.8	20.2	11.6	19.8	9.8	29.0	25.1	
Yields—pounds of heads and stover per acre								
At planting	11954	6519	4503	9024	7288	8525	7969	
12 Inches high	12852	5932	5629	8156	9614	8928	8519	550
24 Inches high	11555	5999	5263	7881	9322	9250	8212	243
No fertilizer	10924	5810	4240	6630	5523	5235	6394	—1575
At planting	11954	6519	4503	9024	7288	8525	7969	

Table VI indicates that slightly higher yields of both grain and total forage were obtained when the nitrogen (from ammonium sulphate) was applied at the time the sagrain was approximately 12 inches high.

Indirect Applications of Commercial Fertilizers

In 1927 sagrain was added to a test that had been running since 1921. This experiment consisted of sources of nitrogen, rates of applying sodium nitrate and dates of applying sodium nitrate with cotton, oats and corn. The sagrain was placed in the test as a crop following the oats and was not fertilized directly but given the benefit of any fertilizer that the oats failed to utilize. The cotton, oats and corn were fertilized just the same each year and rotated as named, with sagrain following the oats in the summer of the same year. For several years (1929-32) sagrain failed to produce mature grain apparently due to a lack of moisture following oats, and during the two years, 1930-1931, sagrain was practically a failure and no yields were taken.

Source of Nitrogen

Table VII shows the results of the sources of nitrogen used.

TABLE VII—Residual Effect of Sources of Nitrogen Applied to a Previous Crop of Oats

Sources of Nitrogen	1927	1928	1929	1932	1933	1934	1935	Average
				Yields—bushels of grain per acre				
Check no fertilizer	30.4	14.1	---	---	5.5	15.8	7.4	8.1
Sodium nitrate	32.3	12.0	---	---	8.2	15.4	10.5	8.7
Ammonium sulphate	34.6	10.7	---	---	8.9	16.1	10.3	9.0
Ammonium sulphate	33.9	11.9	---	---	8.2	15.9	8.2	8.7
Check no fertilizer	30.4	14.1	---	---	5.5	15.8	7.4	8.1
Cyanamid	33.8	14.7	---	---	9.3	13.3	11.8	9.2
Cotton seed meal	36.9	16.1	---	---	10.4	15.7	7.9	9.7
½ C.S.M. & ½ s. nitrate	35.2	16.4	---	---	10.3	15.8	7.9	9.5
Check no fertilizer	30.4	14.1	---	---	5.5	15.8	7.4	8.1
				Increases—bushels of grain per acre				
Sodium nitrate	1.9	—2.1	---	---	2.8	—0.3	3.1	0.6
Ammonium nitrate	4.2	—3.4	---	---	3.4	0.4	2.8	0.8
Ammonium sulphate	3.5	—2.2	---	---	2.7	0.1	0.8	0.6
Cyanamid	3.4	0.6	---	---	3.9	—2.5	4.4	1.1
Cotton seed meal	6.5	2.0	---	---	5.0	—0.1	0.4	1.5
½ C.S.M. & ½ s. nitrate	4.8	2.3	---	---	4.8	0.0	0.5	1.4
				Yields—pounds of heads and stover per acre				
Check no fertilizer	7527	6980	2289	2580	4069	4474	4334	3584
Sodium nitrate	8988	7736	1404	3701	3779	4731	3831	3797
Ammonium nitrate	8405	5588	1620	3414	4782	4800	4437	3672
Ammonium sulphate	7584	6700	1314	3352	4310	4585	3886	3526
Check no fertilizer	7527	6980	2289	2580	4069	4474	4334	3584
Cyanamid	7752	7703	1854	3752	4430	4726	4969	3910
Cotton seed meal	8135	8500	2257	3895	4951	5300	4929	4219
½ C.S.M. & ½ s. nitrate	8225	6970	1606	3137	4491	4900	4339	3741
Check no fertilizer	7527	6980	2289	2580	4069	4474	4334	3584
				Increases—pounds of heads and stover per acre				
Sodium nitrate	1461	756	—885	1121	—290	258	—503	213
Ammonium nitrate	878	—1392	—669	834	713	326	103	88
Ammonium sulphate	57	—281	—975	772	241	112	—448	—58
Cyanamid	225	713	—435	1172	360	252	635	325
Cotton seed meal	608	1520	—33	1315	882	826	595	635
½ C.S.M. & ½ s. nitrate	698	—10	—683	558	421	426	5	157

Table VII indicates that most of the nitrogen was used up by the oats, but greater residual effects on sagrain were obtained with the less soluble sources of nitrogen. Probably the higher yields of oats left a moisture deficiency which resulted in a lower succeeding sagrain yield.

Rates of Applying Sodium Nitrate

The data for the rates of applying sodium nitrate are shown in Table VIII.

TABLE VIII—Residual Effect of Rates of Applying Sodium Nitrate Applied to a Previous Crop of Oats

Rate per Acre	1927	1928	1929	1932	1933	1934	1935	Averag
				Yields—bushels of grain per acre				
Check no fertilizer	33.2	11.2	---	---	10.8	13.6	6.2	8.3
50 lbs. Sodium nitrate	33.9	11.1	---	---	11.3	12.9	5.7	8.3
100 lbs. Sodium nitrate	34.4	8.4	---	---	14.8	12.7	6.0	8.5
150 lbs. Sodium nitrate	31.2	12.1	---	---	10.7	11.9	5.8	8.0
Check no fertilizer	33.2	11.2	---	---	10.8	13.6	6.2	8.3
200 lbs. Sodium nitrate	34.1	10.3	---	---	14.5	10.5	7.0	8.5
250 lbs. Sodium nitrate	38.2	8.2	---	---	15.7	7.8	8.6	8.7
300 lbs. Sodium nitrate	39.5	9.0	---	---	13.1	7.7	8.0	8.6
Check no fertilizer	33.2	11.2	---	---	10.8	13.6	6.2	8.3
				Increases—bushels of grain per acre				
50 lbs Sodium nitrate	0.8	—0.1	---	---	0.5	—0.7	—0.5	0.0
100 lbs. Sodium nitrate	1.2	—2.8	---	---	4.0	—0.9	—0.2	0.5
150 lbs. Sodium nitrate	—2.0	0.9	---	---	—0.2	—1.7	—0.3	—0.3
200 lbs. Sodium nitrate	0.9	—0.9	---	---	3.7	—3.1	0.9	0.5
250 lbs. Sodium nitrate	5.0	—3.1	---	---	4.9	—5.8	2.4	0.4
300 lbs. Sodium nitrate	6.3	—2.3	---	---	2.3	—5.9	1.8	0.3
				Yields—pounds of heads and stover per acre				
Check no fertilizer	6875	5745	2043	3099	5960	3960	4187	354
50 lbs. Sodium nitrate	7850	5582	2357	2992	6090	3903	4192	366
100 lbs. Sodium nitrate	8155	5562	1924	2654	5952	3820	4337	360
150 lbs. Sodium nitrate	8666	5665	1743	2874	5267	4016	3752	355
Check no fertilizer	6875	5745	2043	3099	5960	3960	4187	354
200 lbs. Sodium nitrate	5927	4749	1831	3252	6306	3884	4497	338
250 lbs. Sodium nitrate	9712	4728	1699	2992	6583	3933	4821	383
300 lbs. Sodium nitrate	9424	5010	1272	3229	5977	3486	4364	364
Check no fertilizer	6875	5745	2043	3099	5960	3960	4187	354
				Increases—pounds of heads and stover per acre				
50 lbs. Sodium nitrate	975	—163	314	—108	130	—57	5	12
100 lbs Sodium nitrate	1280	—183	—119	—445	—8	—140	150	5
150 lbs. Sodium nitrate	1791	—80	—300	—225	—693	56	—435	1
200 lbs. Sodium nitrate	—948	—996	—212	153	346	—76	310	—15
250 lbs. Sodium nitrate	2837	—1017	—344	—107	623	—27	634	28
300 lbs. Sodium nitrate	2549	—735	—771	130	17	—474	177	9

Table VIII indicates that the different rates of application of sodium nitrate to a crop of oats had little, if any residual effect on a succeeding crop of sagrain. In several cases the yields were decreased on the fertilized plots, presumably from a moisture and perhaps an available plant food deficiency caused by high preceding oat yields.

Dates of Applying Sodium Nitrate

Table IX shows the results of the residual effect of various dates of applying sodium nitrate to a previous crop of oats on a crop of sagrain.

TABLE IX—Residual Effect of Dates of Applying Sodium Nitrate to a Previous Crop of Oats

Date of Application	1927	1928	1929	1932	1933	1934	1935	Average
				Yields—bushels of grain per acre				
heck no fertilizer	37.0	10.0	---	---	10.2	10.2	12.2	8.8
t planting	44.3	10.2	---	---	10.9	6.7	15.7	9.8
arch 15	41.9	9.4	---	---	8.2	5.1	21.8	9.6
pril 1	45.2	11.5	---	---	8.7	5.0	24.3	10.5
heck no fertilizer	37.0	10.0	---	---	10.2	10.2	12.2	8.8
pril 15	43.2	10.2	---	---	10.2	5.7	20.0	9.9
½ Pltg., ½ April 1	41.7	11.3	---	---	8.8	5.2	20.7	9.7
½ Pltg., ½ April 15	49.0	10.0	---	---	11.2	5.2	19.2	10.5
heck no fertilizer	37.0	10.0	---	---	10.2	10.2	12.2	8.8
				Increases—bushels of grain per acre				
t planting	7.9	0.2	---	---	0.7	—3.6	3.4	1.0
arch 15	4.9	—0.6	---	---	—2.0	—5.1	9.5	0.7
pril 1	8.2	1.5	---	---	—1.6	—5.2	12.1	1.7
pril 15	6.3	0.2	---	---	0.0	—4.5	7.8	1.1
½ Pltg., ½ April 1	4.8	1.2	---	---	—1.4	—5.1	8.4	0.9
½ Pltg., ½ April 15	12.0	0.0	---	---	1.0	—5.0	6.9	1.7
				Yields—pounds of heads and stover per acre				
heck no fertilizer	7848	6094	1998	3835	3860	3637	7277	3839
t planting	8654	5292	1550	3362	4371	3449	5713	3599
arch 15	8233	5199	1552	3923	3763	3285	7395	3706
pril 1	9139	5354	1298	3925	4026	3319	8551	3957
heck no fertilizer	7848	6094	1998	3835	3860	3637	7277	3839
pril 15	8382	5477	1363	4098	4597	3678	8652	4027
½ Pltg., ½ April 1	8582	5389	1470	3609	4171	3701	9239	4018
½ Pltg., ½ April 15	9421	5408	1566	3669	3754	3458	9062	4038
heck no fertilizer	7848	6094	1998	3835	3860	3637	7277	3839
				Increases—pounds of heads and stover per acre				
t planting	806	—802	—448	—473	511	—188	—1564	—240
arch 15	385	—895	—446	88	—97	—352	118	—133
pril 1	1291	—740	—700	90	166	—318	1274	118
pril 15	534	—617	—635	263	737	41	1375	189
½ Pltg., ½ April 1	734	—705	—528	—226	311	64	1962	179
½ Pltg., ½ April 15	1573	—686	—432	—166	—106	—180	1785	198

The results in Table IX indicate that there were slight residual effects on the sagrain from the later applications of sodium nitrate, but in some cases all yields of sagrain were reduced from the use of sodium nitrate on the preceding crop of oats.

Tables VII, VIII, and IX indicate that only slight residual effects on a succeeding crop should be expected from applications of commercial nitrogen applied to a preceding crop of oats.

Residual Effect of Sagrain, Corn, and Varieties of Soybeans on a Succeeding Crop of Cotton

As sagrain produces heavily and removes much plant food from the soil, and since some varieties of soybeans produce higher yields than others, thereby adding more nitrogen to the soil, a test was started in 1928 to determine which variety of soybeans would increase or maintain soil fertility when grown with sagrain.

Corn was added to the test to compare the residual effect of corn and soybeans with that of sagrain and soybeans. The plan was to grow cotton as a succeeding crop to measure the residual effect of the different varieties of soybeans in the sagrain and corn. Table X presents the results of this work.

TABLE X—Sagrain, Corn and Varieties of Soybeans and Residual Effect of Same on a Succeeding Crop of Cotton

Crops grown	1928	1929	1930	1931	1932	Average Yield	Average Increas
Total yields—pounds of sagrain, corn and soybeans per acre							
Sagrain & Geo. Wash. soybeans	7775	2700	6041	5877	5658	5610	
Corn & Biloxi soybeans	6930	3690	1166	4230	2903	3784	—182
Sagrain & Biloxi soybeans	7606	3618	6530	6091	5731	5915	30
Sagrain & Loxitan soybeans	7845	3492	6757	6136	5730	5992	38
Sagrain & Tokyo soybeans	8752	3582	5960	6166	4717	5835	22
Sagrain & Geo. Wash. soybeans	7775	2700	6041	5877	5658	5610	
Yields of succeeding cotton crops—seed cotton in pounds per acre							
Sagrain & Geo. Wash. soybeans		1834	705	573	679	758	
Corn & Biloxi soybeans		2026	683	797	723	846	8
Sagrain & Biloxi soybeans		2008	808	567	768	830	7
Sagrain & Loxitan soybeans		1916	684	657	659	783	2
Sagrain & Tokyo soybeans		1890	735	608	743	795	3
Sagrain & Geo. Wash. soybeans		1834	705	573	679	758	

The results in Table X indicate very little variation in yields of sagrain and different varieties of soybeans, but sagrain and soybeans produced considerably higher yields than corn and the same variety of soybeans. The yields of succeeding cotton crops indicate that slightly higher yields were obtained from the residual effects of Biloxi soybeans than from the other varieties. The 4 year average cotton yields show practically no difference between the residual effect of sagrain and soybeans and corn and soybeans.

SAGRAIN PASTURE

For several years this station has been pasturing sagrain with mules and hogs. No experimental results are available, but general opinions have been formed in connection with this practice.

From general observations it seems that 1½ acres of sagrain and soybeans per head is sufficient to carry mules through the summer and fall idle period (July 15-December 15). If the pasture is planted on good land or well fertilized, the acreage can probably be reduced 25 to 50%.

Hogs were usually turned in after the mules were taken off the pasture to utilize the feed wasted by the mules. Some economical gains have also been obtained with hogs by pasturing them on fields of sagrain that have not been previously pastured by mules.

This 16-acre sagrain pasture provided both grain and roughage for 20 station mules during the fall idle period.

These 20 mules gained 1646 pounds on the above sagrain pasture the first 33 days or an average of 2.5 pounds per mule per day.

SAGRAIN SHOCKING

In 1927 a test was conducted to determine the most economical and satisfactory method of curing and winter storing sagrain forage in the open.

The following types of shocks were put up in duplicate on December 5, 1927 and torn down and notes made March 12, 1928.

1. Shocks 14 feet long and 2 bundles thicks on each side of ridge pole.
2. Shocks 14 feet long and 4 bundles thick on each side of ridge pole.
3. Round shocks containing 12 bundles.
4. Round shocks containing 24 bundles.
5. Round shocks containing 24 bundles at the base and shingled with 12 more bundles.

Ridge poles 3½ feet high were used in plots 1 and 2.

Posts in center of shocks were used in plots 3, 4 and 5.

The 14 foot long and two bundles thick shocks seemed to be the most practical method of curing and storing sagrain in the open. The bundles were cured sufficiently, remained dry throughout with practically no mold present. This method could be used on pasture and other fences very economically. The heads should be covered to prevent birds from destroying the grain.

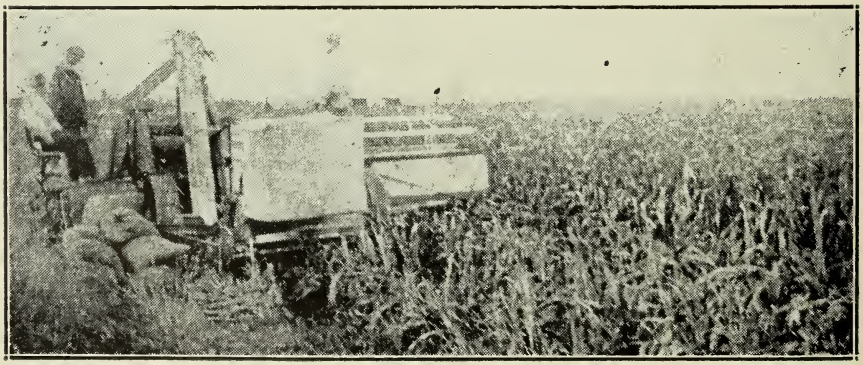
When the 14 foot shocks were increased to four bundles thick the inside bundles failed to cure properly and were wet and molded.

The sagrain in the 12 bundle round shock was in better condition than in any of the methods used, but this method required too much time, labor, space and expense as compared to shocking around a permanent farm fence.

The round shock containing 24 bundles were in fair condition and required less time, labor, space and expense than the 12 bundle round shocks.

The shingled round shock was an absolute failure. The bundles fell down on the ground, and were wet and molded.

A field of shocked sagrain on a Yazoo-Mississippi Delta plantation.



Combining sagrain on a Yazoo-Mississippi Delta plantation.

SUMMARY

The results of nine years of experimental work with sagrain at the Delta Experiment Station consisting of dates of seeding, spacing, soil fertility, pasture and shocking investigations may be summarized as follows:

1. Sagrain produced highest yields of grain on a Sharkey sandy loam soil when planted April 15 and highest yields of forage when planted May 1-15.

2. In hills 13 inches apart on Sharkey clay loam soil 4 to 6 plants per hill produced the highest average yields of grain and 5 or more plants produced the highest forage yields of sagrain alone. Six or more plants per hill produced highest yields of both grain and stover with soybeans in alternate hills. The soybeans reduced the sagrain yields considerably when the total crop was removed from the land each year, however the grain from the soybeans and the better quality feed offset the reduced yields of sagrain.

3. As a nine year average the six commercial sources of nitrogen at the rate of 30 pounds of nitrogen per acre increased the yields as follows: Calurea, 9.8 bushels per acre; calcium nitrate, 9.8 bushels; sodium nitrate, 9.7 bushels. ammonium sulphate. 10.3 bushels; leunasalpeter, 10.4 bushels; and cyanamid, 7.3 bushels per acre. The average check yield was 16.1 bushels per acre.

4. The most economical rate of applying ammonium sulphate was 150 pounds per acre.

5. Slightly higher yields of both grain and total forage were obtained when the nitrogen (from ammonium sulphate) was applied at the time the sagrain was approximately 12 inches high.

6. Only very slight residual effects on sagrain were obtained from applications of commercial nitrogen on a preceding crop of oats.

7. Considerably higher yields were obtained with sagrain and soybeans than corn and soybeans and the succeeding cotton yields were practically the same. Slightly higher yields of cotton were obtained from the residual effects of Biloxi soybeans than from the other varieties used with sagrain.

8. One and one half acres of sagrain and soybeans per head were sufficient to carry mules through the summer and fall idle period (July 15 to Dec. 15).

9. Sagrain forage shocked two bundles thick on each side of a ridge pole or farm fence was the most satisfactory and economical method of curing and storing during the winter in the open.

AN ALLUVIAL EMPIRE