Mississippi State University

Scholars Junction

Bulletins

Mississippi Agricultural and Forestry Experiment Station (MAFES)

4-1-1961

Fertility practices for cotton and corn in the Yazoo-Mississippi Delta

Perrin H. Grissom

W. I. Spurgeon

Follow this and additional works at: https://scholarsjunction.msstate.edu/mafes-bulletins

Recommended Citation

Grissom, Perrin H. and Spurgeon, W. I., "Fertility practices for cotton and corn in the Yazoo-Mississippi Delta" (1961). *Bulletins*. 437.
https://scholarsjunction.msstate.edu/mafes-bulletins/437

This Article is brought to you for free and open access by the Mississippi Agricultural and Forestry Experiment Station (MAFES) at Scholars Junction. It has been accepted for inclusion in Bulletins by an authorized administrator of Scholars Junction. For more information, please contact scholcomm@msstate.libanswers.com.

1764B
#614

BULLETIN 614 APRIL, 1961

Fertility Practices for Cotton and Corn in the Yazoo-Mississippi Delta

CONTENTS

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

Summary

Cotton.—

1. Differences in the effect of nitrogen sources on cotton yields were small.
2. Urea-ammonium nitrate solution was equal to anhydrous ammonia and ammonium nitrate for cotton.
3. Maximum yields of cotton were produced by nitrogen rates ranging from 90 to 120 pounds per acre.
4. Maximum earliness of cotton was obtained by using 60 pounds of nitrogen per acre.
5. Nitrogen applied before planting produced slightly higher yields than side dressing treatments.
6. Varying the placement distance from the drill had no effect on yields.
7. Nitrogen placed 8 to 14 inches deep resulted in higher yields than shallower application.
8. Nitrogen applied in the fall was less effective than spring-applied nitrogen.
9. Cotton responded to phosphorus in 7 of 48 tests when sites were selected at random and in 4 of 10 tests when locations were selected because soil tests indicated a probable response.
10. Cotton responded to potash in 9 of 48 tests when sites were selected at random and in 4 of 12 tests when locations were selected because soil tests indicated a probable response.
11. The application of lime increased the yield of cotton in 2 of 33 tests.
12. The application of magnesium did not affect cotton yields.
13. Cotton yields were not increased by minor elements .
14. There are areas in the Delta which are deficient in sulfur.

Corn.—

1. Differences in corn yields due to nitrogen sources were small.
2. Maximum corn yields resulted from 120 pounds of nitrogen per acre.
3. Pre-plant application of nitrogen produced slightly higher yields than side dressing.
4. Ammonium nitrate was more effective for side dressing corn than anhydrous ammonia when both were placed 6-7 inches deep.
5. Varying the distance of applying nitrogen from the drill had no effect on yields.
6. Corn yields increased as the depth of applying nitrogen increased to a 8-inch depth.
7. Corn yields were increased by phosphorus in 1 test in 31 tests at locations chosen at random.
8. In 31 tests at random sites potash did not affect yields.
9. In 22 tests lime had no effect on corn yields.
10. In 12 tests magnesium had no effect on yields.

FERTILITY PRACTICES FOR COTTON AND CORN IN THE YAZOO-MISSISSIPPI DELTA

By PERRIN GRISSOM And W. I. SPURGEON[1]

The work reported in this bulletin covers a period from 1949 through 1960. The experiments were designed to obtain data which would permit the revision of old recommendations and the development of new ones pertaining to the fertilization of cotton and corn.

In so far as possible, recommended cultural practices were employed in all of the experiments. The varieties planted were equal to or superior to the best on the recommended list. Insect control was practiced at a level consistent with, or more intense than, generally recommended. Land preparation, weed control, and cultivation were practiced in a conventional manner including the use of preemergence chemicals on cotton in the tests at the Delta Station beginning with 1956. In the experiments with cotton the plant population ranged from 3 to 5 stalks per hill spaced 14 to 20 inches apart, with row widths of 38 to 40 inches. In the corn experiments at the Experiment Station, plants were spaced one foot apart with rows 40 inches apart. In outlying tests a spacing between plants of 12 to 15 inches was attempted.

Cotton Fertilization

Sources of Nitrogen for Cotton

The experiment of longest duration which compared sources of nitrogen for cotton at the Delta Branch of the Mississippi Agricultural Experiment Station was started in 1921 and was concluded in 1957. The experiment was located on an area where Bosket silt loam predominated but where small areas of Dubbs silt loam were present. A rotation of cotton-oats-corn was practiced except in the first few years of the test. Each plot was treated with the same source of nitrogen regardless of which crop was being grown, The sources of nitrogen compared were sodium nitrate, ammonium nitrate, ammonium sulphate, cyanamid, cottonseed meal, and a mixture consisting of one-half cottonseed meal and one-half sodium nitrate. The rate of application was 30 pounds of nitrogen per acre through 1951.

In 1952 anhydrous ammonia was substituted for the mixture of cottonseed meal and nitrate of soda and the rate of nitrogen was changed to 90 pounds per acre for cotton. At the same time the rate of nitrogen was changed to 45 pounds per acre for oats and 120 pounds per acre for corn. Since the crops were rotated the rates on oats and corn have to be considered in interpreting the total effect of sources.

The variety of cotton changed several times during the experiment, however, no drastic changes in plant type or yielding ability occurred between any two years although there was a gradual shift to better varieties. The planting date varied with weather conditions but in 3 out of each 4 years the cotton was planted between May 1 and May 10.

[1]Agronomist and Assistant Agronomist, respectively, Delta Branch of the Mississippi Agricultural Experiment Station, Stoneville, Mississippi.

Table 1. Effect of sources of nitrogen on the yield of cotton, Delta Station.

Treatment	1921-1951 average	1952-1957 average	37-Year average
	Pounds of seed cotton per acre		
No nitrogen	1094	1002	1079
Sodium nitrate	1633	2031	1698
Ammonium nitrate	1634	2115	1712
Ammonium sulphate	1578	2124	1667
Cyanamid	1571	2055	1649
Cotton seed meal	1505	1531	1509
One-half cotton seed meal and one-half sodium nitrate	1539	.....	.....
Anhydrous ammonia	.....	2135	.....

Soil type—Bosket silt loam predominates with small areas of Dubbs included.
Rate of nitrogen—30 pounds per acre 1921 through 1951.
90 pounds per acre 1952 through 1957.
Time of application—one to three weeks before planting.

The 37-year results (*Table 1.*) show only small differences between nitrogen sources, except the yield from cottonseed meal was lower than from other materials.

The influence of a nitrogen source on soil acidity is an important consideration that may affect its efficiency. No records are available indicating the pH of the soil at the beginning of the experiment described above. In 1942 the ammonium sulphate plots had a pH of 6.30, the check plots had a pH of 6.70, and the plots treated with nitrate of soda had a pH of 7.0. At the conclusion of the experiment a total of 1440 pounds of nitrogen per acre had been applied. Of this amount, 810 pounds of nitrogen were applied in the last 16 years. In 1957, the ammonium sulphate plots had an average pH of 5.87, the check plots had a pH of 6.30, the nitrate of soda plots were 6.74. Although the ammonium sulphate plots had increased in acidity more than other treatments the acidity had not increased enough to affect yields.

There have been numerous additional tests which compared nitrogen sources. Some of the results of other tests were reported in Mississippi Agricultural Experiment Station Bulletin 473 published in 1950. Several of these experiments compared nitrogen sources at different rates. The highest rate of application was 60 pounds of N per acre.

In one test described in Bulletin 473, located at the Delta Station the original rates were 30, 45, and 60 pounds of N per acre. In 1951 the rates were changed to 30, 60, and 90 pounds per acre with the 90-pound rate substituted for 45 pounds. In 1954 a 120-pound rate was substituted for the 30-pound rate. When sources of nitrogen were compared at different rates for the 5-year period 1955-1959, the average yields show no significant difference between sources. (*Table 2*) There were indications of differences, although not statistically significant, within individual years. Soil variation accounted for some of the yield variations. Cyanamid was included in the experiment originally but was eliminated because of the toxic effect of the 120-pound rate on young plants.

Urea was tested as a source of nitrogen in the Delta 20 to 30 years ago and generally proved equal or almost equal to other nitrogen sources. In view of the increased production of urea in recent years it appeared desirable to collect current data on the efficiency of urea. A test was initiated in 1954 to compare urea with anhydrous ammonia and ammonium nitrate at 3 rates of application. The results (*Table 3*) show no significant differences among sources and in-

Table 2. Average yield of cotton for 5-year period with different sources of nitrogen when applied at different rates, Delta Station, 1955-59.

Nitrogen source	60 pounds of N per acre	90 pounds of N per acre	120 pounds of N per acre
	Pounds of seed cotton per acre		
No nitrogen	1794	1814	1791
Ammonium nitrate	2510	2505	2655
Ammonium sulphate	2448	2477	2641
Anhydrous ammonia	2406	2514	2600
Sodium nitrate	2370	2526	2563

Soil type—Bosket silt loams.
Time of application—Preplant.

Table 3. Urea compared with anhydrous ammonia and ammonium nitrate as a source of nitrogen for cotton, Delta Station.

Nitrogen source	1954	1955	1956	1957	1958	Average
No treatment	1648	2076	1369	1588	1663	1669
Urea	1854	2937	1993	2084	2908	2355
Ammonium nitrate	1910	2992	2024	2063	2981	2394
Anhydrous ammonia	1881	3014	2043	2030	2903	2374

Soil type—Bosket loam
Rate of nitrogen—Each yield figure represents an average of plots receiving treatments at the rate of 60, 90, and 120 pounds of N per acre.
Time of application—3 to 8 days before planting.
Depth of application—6 to 8 inches deep.

Table 4. Urea-ammonium nitrate solution compared with ammonium nitrate for cotton production, Delta Station.

Treatment	Preplant application				Sidedressing application			
	1957	1959	1960	3-Yr. avg.	1957	1959	1960	3-Yr. avg.
	Pounds of seed cotton per acre							
No treatment	1350	1740	2299	1796	.....	2010	1777	.....
Ammonium nitrate, surface	2088	2388	2715	2397	1666	2568	1955	2063
Urea-ammonium nitrate, surface	2095	2373	2629	2366	1712	2588	1810	2037
Ammonium nitrate, 6" deep	2164	2628	2765	2519	1677	2645	1908	2077
Urea-ammonium nitrate, 6" deep	2113	2697	2513	2441	1542	2564	1739	1948

Soil type—Bosket silt loam.
Rates of application—60 pounds of nitrogen per acre.
Time of application—preplant - 3-10 days before planting.
sidedressing - when cotton was 5-7 weeks old.
1958 results discarded because of suggestion of faulty application equipment.

dicate urea to be equal to anhydrous ammonia and ammonium nitrate for cotton when applied in the soil.

In 1957 tests were started to collect data comparing non-pressure nitrogen solutions with other nitrogen sources. Previous work at this Station in 1942 and 1943 indicated that non-pressure nitrogen solutions and those with very low pressure containing some free ammonia were satisfactory sources of nitrogen. In the recent tests a urea-ammonium nitrate solution containing 32 percent nitrogen has been compared with injection into trate. Surface applications have been compared with injection into the soil.

Results (*Table 4*) show only slight differences between ammonium nitrate and urea-ammonium nitrate. Both materials were slightly more effective when applied 6" deep than when applied on the

Table 5. The influence of rates of nitrogen on the yield of cotton, Delta Branch Experiment Station, 1921-1957.

Year	No nitrogen	Pounds of nitrogen per acre 7.5	15.0	22.5	30.0	37.5	45.0
		Yields in pounds of seed cotton per acre					
1921	1384	1461	1562	1702	1723	1803	1705
1922	733	834	902	967	972	1008	1083
1923	457	622	768	879	991	958	874
1924	1168	1190	1198	1309	1369	1470	1456
1925	2604	3060	2965	3020	2903	3010	3050
1926	2074	2216	2362	2554	2863	3112	3102
1927	1315	1503	1657	1927	2704	2780	2790
1928	1628	1838	1959	2023	2201	2313	2390
1929	1382	1543	1663	1820	2038	2127	2257
1930	801	853	893	1115	1113	1136	1149
1931	1189	1326	1410	1444	1411	1556	1542
1932	645	711	828	889	963	1012	1052
1933	886	973	1091	1235	1493	1542	1656
1934	778	854	939	964	1012	1036	1075
1935	1048	1179	1207	1370	1434	1599	1651
1936	777	840	999	1082	1169	1085	1121
1937	902	1106	1257	1452	1620	1765	1798
1938	1167	1275	1417	1681	1781	1931	1999
1939	961	1036	1210	1244	1556	1545	1540
1940	949	1080	1252	1444	1549	1575	1586
1941	1104	1220	1435	1654	1875	2079	2236
1942	886	956	1198	1455	1487	1581	1794
1943	945	1045	1127	1247	1357	1421	1456
1944	836	923	1061	1284	1498	1437	1508
1945	654	869	1060	1424	1539	1763	1753
1946	736	817	1065	1116	1160	1331	1508
1947	903	1313	1168	1285	1577	1674	1868
1948	866	981	1163	1436	1610	1880	1917
1949	874	965	1134	1243	1419	1515	1585
1950	557	774	896	921	1035	1126	1076
1951	678	687	816	921	1042	1079	1127
1952	840	758	944	1050	1315	1468	1563
1953	1151	1253	1658	1785	1945	2086	2156
1954	995	1067	1267	1318	1415	1377	1384
1955	1194	1161	1382	1583	1825	2122	2399
1956	686	729	797	914	1161	1245	1237
1957	1088	1582	1642	1682	1740	1759	1977
Avg.	1023	1151	1280	1418	1564	1657	1714

Soil type—Bosket silt loam
Source of nitrogen—Sodium nitrate

surface before planting. Placement had no effect on sidedressing application. Failure to show a difference because of placement may have been due to the relatively low response to nitrogen.

Rates of Nitrogen for Cotton

The nitrogen rates test of longest duration at the Delta Station was begun in 1921 and was continued through 1957. This test was conducted in a manner similar to the long-time sources test described earlier. Cotton, corn, and oats were rotated but the nitrogen rates remained the same on each plot regardless which crop was being grown. Nitrate of soda was used as the source of nitrogen and was applied before planting. These results show an increase in yield of cotton as the rate of nitrogen increased. (*Table 5*) The degree of increase varied with years.

Mississippi Agricultural Experiment Station Bulletin 473 listed results with other nitrogen rates experiments, although only one test was reported where rates exceeded 75 pounds of nitrogen per acre. Several tests have been conducted in recent years where higher rates have been compared. Table 6 lists the annual yields of cotton where rates of nitrogen range from 45 pounds per acre to 150 pounds per acre. In this experiment one-half of each plot was treated with early applications of insecticide for control of thrips. Except in 1950 the thrips control did not affect yield or earliness of cotton. Therefore, each yield figure represents an average of treated and untreat-

Table 6. Effect of rates of nitrogen on cotton production at Delta Station, 1950-1958.

Pounds N/A	1950	1951	1952	1953	1954	1955	1956	1957	1958	Avg.	Increase over check
						Pounds of seed cotton per acre					
0	1241	1100	1524	1910	1005	1960	1314	1625	1837	1502	.....
45	1776	1626	1928	2357	1476	2652	1611	2130	2290	1983	481
60	1806	1607	2014	2541	1412	2925	1830	2087	2413	2071	569
75	1874	1611	2152	2691	1411	2955	1810	2140	2470	2124	622
90	1711	1620	2152	2670	1484	3000	1810	2228	2754	2159	657
105	1500	1540	2147	2771	1476	3015	1852	2033	2709	2166	614
150	1001	1475	2177	2826	1543	2928	1749	1912	2733	2038	536

Soil type—Bosket - Dubbs silt loam complex.
Nitrogen source—anhydrous ammonia.
Time of application—one to three weeks before planting.

Table 7. Effect of rates of nitrogen on cotton production at Delta Station, 1951-1956.

Pounds N/A	1951	1952	1953	1954	1955	1956	6-Yr. avg.	Increase over check
				Pounds of seed cotton per acre				
0	700	870	1360	1074	1001	743	958	.....
45	1098	1771	2329	1202	2005	1523	1655	697
60	1290	2091	2544	1224	2339	1685	1862	904
75	1431	2258	2795	1403	2347	1868	2017	1059
90	1423	2369	2759	1374	2429	1850	2034	1076
105	1470	2407	2874	1601	2638	2006	2166	1208
120	1447	2540	2962	1523	2701	2014	2198	1240

Soil type—Bosket silt loam.
Source of nitrogen—Anhydrous ammonia.
Time of application—one to three weeks before planting.

ed with respect to early insects. The response to nitrogen was somewhat low and the highest average yields were obtained with 90 pounds of nitrogen per acre. However, there were no significant differences among 75, 90, and 105 pounds of nitrogen per acre. The yield of cotton was reduced by applying 150 pounds of nitrogen per acre.

In a nitrogen rates test which ran for 6 years, (*Table 7*) the highest yield was obtained with 120 pounds of nitrogen per acre but there were only 32 pounds of seed cotton per acre more than on the 105 pound rate.

Table 8. Summary by years of rates of nitrogen influence on seed cotton yields in dual objective experiments, Delta Station.

Pounds of N/A	1951	1952	1953	Avg.
	Sources & Rates Test			
0	1187	1836	2004	1676
30	1411	1972	2472	1952
60	1751	2388	2525	2221
90	1713	2234	2730	2226

	1954	1955	1956	1957	1958	1959	1960	Avg.
	Sources & Rates Test							
0	1397	2057	1430	1717	1887	1906	2040	1777
60	1698	2861	1943	1986	2762	2614	2568	2347
90	1565	2876	2025	2060	2745	2859	2480	2373
120	1513	2948	1891	2133	3087	3019	2720	2473

	1951	1952	1953	Avg.
	NPK Test			
30	1422	1634	2065	1707
60	1610	1854	2307	1924

	1954	1955	1956	1957	1958	1959	1960	Avg.
	NPK Test							
60	1960	2869	1534	2304	2492	2684	2314	2308
90	1726	3036	1689	2279	3053	3032	2418	2462
120	1763	3130	1642	2333	3086	3137	2447	2505

	1954	1955	1956	1957	1958	Avg.
	Urea Versus Other Sources					
0	1648	2076	1369	1588	1663	1669
60	1826	2913	1824	2290	2732	2317
90	2008	3027	2142	2084	3007	2454
120	1812	3003	2051	1804	3052	2344

	1952	1953	1954	3-Yr. av.	1955	1956	1958	3-Yr. Avg.
	Rates of Nitrogen & Irrigation							
60	2317	2639	2224	2393	.....	.....	.....	.....
90	2465	2813	2481	2586	2702	1589	2490	2260
120	2727	3080	2321	2709	2665	1763	2474	2301
150	.....	.....	.....	.....	2585	1840	2347	2257

Results of several experiments in which rates of nitrogen were varied in conjunction with other variables, (*Table 8*) show that highest yields were obtained with 90 or 120 pounds of nitrogen per acre. In most cases the difference between the two rates was not significant.

A test was initiated in 1954 to study the effect of extremely high rates of nitrogen on cotton production. The 7- year results of this experiment (*Table 9*) show application of 120 pounds of nitrogen per acre resulted in the highest average yield. The average yield of the untreated plot was higher than normally would be expected and it is possible that some movement of nitrogen occurred from the treated plots. A point of interest in connection with this test was that considerable lodging occurred in some years when the rate of application exceeded 180 pounds per acre.

The influence of rates of nitrogen on earliness of cotton is an important consideration which might influence the economy of higher rates of application. Most of the experiments which are described in this bulletin were picked twice. However, in some years a major portion of the cotton was open at the first picking. In an attempt to make some appraisal of the effect of nitrogen rates on earliness of cotton the amount of cotton harvested at the first picking, where less than two-thirds of the total crop was open, is used. Although, the results are not as consistent as would be desired, the application of 60 pounds of nitrogen per acre resulted in the largest amount of cotton harvested at the first picking (*Table 10*). With one exception rates of nitrogen above 60 pounds per acre reduced the amount of cotton at first harvest.

Time of Applying Nitrogen

Previous work has shown highest yields have usually been produced by applying nitrogen near planting time. Sidedressing usually resulted in slightly lower yields than preplanting application. An experiment was begun in 1950 to study the influence of rate of nitrogen on the response of cotton to time of application. In this experiment the original rates were 30, 45, 60, and 75 pounds of nitrogen per acre. In 1955 a 90-pound rate was substituted for the 30-pound rate.

At the lower rates of nitrogen there appeared to be a slight advantage for applying the nitrogen

Table 9. Rates of nitrogen for cotton production.

Pounds N/acre	1954	1955	1956	1957	1958	1959	1960	7-Year average
	Pounds of seed cotton per acre							
0	1584	1963	1449	1942	2129	1975	2012	1865
60	1774	2765	1762	2278	2611	2732	2293	2316
120	1929	2848	1774	2614	3136	2970	2546	2545
180	1833	2911	1766	2243	3053	2961	2427	2456
240	1711	2807	1937	1839	2952	2902	2626	2396
300	1616	2697	1822	1981	2807	2590	2552	2295
360	1774	2715	1897	2308	2721	2409	2664	2355

Soil type—Dubbs silt loam.
Source of nitrogen—Anhydrous ammonia.
Time of application—Prior to planting.

Table 10. Effect of rates of nitrogen on the amount of cotton harvested at first picking in 6 experiments.

Pounds of N. per A	Test 1 4-yr. av.	Test 2 2-yr. av.	Test 3 2-yr. av.	Test 4 4-yr. av.	Test 5 3-yr. av.	Test 6 3-yr. av.
	Pounds of seed cotton per acre					
0	1015	.....	915	992	1080	673
45	1469	.....	.....	1252	.....	1064
60	1522	1589	1223	1198	1451	1058
90	1483	1503	973	1111	1326	1219
120	.....	1385	782	.....	1266	1207
150	.....	.....	.....	874	.....	.....

Test 1—Rates & time of applying ammonia, 1952, 1955, 1956, and 1958.
Test 2—NPK, 1955 and 1958.
Test 3—Urea compared with ammonia and ammonium nitrate 1955 and 1958.
Test 4—Rates of N - - - - 1950, 1951, 1955, and 1958
Test 5—Sources and rates of nitrogen - 1955, 1956, and 1958.
Test 6—Rates of N - - - - 1951, 1952, and 1953

as a split application or as a sidedressing, (*Table 11*). As the rate of nitrogen increased the preplanting application gained an advantage. The highest yields produced in the experiment were when the highest rate of nitrogen was applied before planting.

A question frequently arises as to how late nitrogen may be applied with beneficial results. Previous work has shown July nitrogen applications relatively inefficient but has shown some benefit. Late sidedressing has been doubtful. Four year's sidedressing with ammonium nitrate at the rate of 30 pounds of N per acre during the last weeks of July or the first week of August gave positive results in only one year. In 1957 nitrogen applied August 6 increased the yield of cotton 300 pounds of seed cotton per acre. Observations suggest the beneficial results one year in four from late sidedressing may be even greater than can normally be expected.

A series of experiments was started in 1955 to compare fall application of nitrogen for cotton with spring-applied nitrogen. Previous work had shown considerable variation in the response of cotton to fall-applied nitrogen. Bulletin 473, referred to earlier, reports the 13-year results of one test where fall-applied nitrogen was almost equal to spring-applied nitrogen. Other tests have produced different results. Anhydrous ammonia applied in December of 1952 resulted in a yield of 2469 pounds of seed cotton per acre while a May application produced 2721 pounds per acre.

In the experiments begun in 1955 three sources of nitrogen were used and applied at the rates of 60 and 120 pounds per acre. Tests were located at 8 sites. At 3 of the locations there was no response to nitrogen indicating a high carryover from the previous crop. The yield obtained in the responsive tests are shown in Table 12. Since the fall of 1955, weather conditions and other factors have prevented as many tests as in 1955-56. Tests were conducted at two places in 1957 and at two places in 1960. The yields in these tests are also reported in Table 12. When all of the cotton yields are averaged there is a consistent advantage for spring-applied nitrogen. However, at 3 of the 5 locations in 1955 there were no significant differences due

Table 11. Rates and time of applying nitrogen for cotton, Delta Station. 1950-1958.

Pounds N per acre	Time of application	1950	1951	1952	1953	4-Yr. avg.	1955	1956	1957	1958	4-Yr. avg.	8-Yr. avg.
		Pounds of seed cotton per acre										
....	No treatment	1518	1096	1417	1827	1465	1574	1099	945	1562	1295	1380
30	Preplant	1895	1318	1764	1963	1735	.....	.....	.....	.....	.....	.....
30	1/2 Preplant - 1/2 Sidedress	1916	1361	1732	2204	1803	.....	.....	.....	.....	.....	.....
30	Side dress	2046	1488	1913	2228	1919	.....	.....	.....	.....	.....	.....
45	Preplant	1948	1612	1919	2198	1919	2738	1696	1747	2242	2106	2013
45	1/2 Preplant - 1/2 Sidedress	2082	1565	1999	2358	2001	2536	1723	1588	2052	1975	1988
45	Side dress	2073	1543	2017	2519	2038	2426	1749	1431	2135	1935	1987
60	Preplant	2043	1706	1948	2331	2007	2723	1883	1920	2465	2248	2128
60	1/2 Preplant - 1/2 Sidedress	2225	1615	2026	2530	2099	2726	1883	1860	2355	2206	2153
60	Side dress	2002	1623	1949	2519	2023	2468	1951	1607	1382	2102	2063
75	Preplant	2124	1677	2061	2519	2095	2774	1945	2025	2590	2334	2215
75	1/2 Preplant - 1/2 Sidedress	2088	1673	2070	2548	2095	2667	1889	1782	2726	2266	2181
75	Side dress	1779	1601	2037	2673	2023	2539	1978	1823	2691	2258	2141
90	Preplant	.....	.....	.....	.....	.....	2839	2094	1679	2786	2350	.....
90	1/2 Preplant - 1/2 Sidedress	.....	.....	.....	.....	.....	2711	2052	1623	2729	2279	.....
90	Side dress	.....	.....	.....	.....	.....	2443	2100	1401	2700	2161	.....

Soil type—Dubbs and Bosket silt loam.
Nitrogen source—Anhydrous ammonia.

Table 12. Fall versus spring application of nitrogen for cotton production on different soil types.

Pounds of N per acre	Source	Time of application	Soil type and years S-424 1956	S-322 1956	S-436 1956	S-436 1957	W-322 1956	W-322 1960	W-456 1956	W-456 1957	W-456[1] 1960	Years & soil types avg.
			Pounds of seed cotton per acre									
No nitrogen			1061	914	1858	1215	1184	1451	939	563	1822	1223
60	Nitrate of soda	Fall	1283	1377	2033	1789	1326	2050	1319	1007	2317	1611
60	Nitrate of soda	Spring	1192	1319	1925	2045	1421	2331	1446	1926	2736	1816
60	Ammonium nitrate	Fall	1341	1388	1963	1856	1442	1862	1194	1355	2472	1653
60	Ammonium nitrate	Spring	1282	1422	2007	1956	1450	2305	1393	1700	2614	1792
60	Anhydrous ammonia	Fall	1325	1249	2079	1721	1445*	1812	1348	1744	2433	1684
60	Anhydrous ammonia	Spring	1265	1298	2074	1951	1514*	2204	1268	2419	2507	1833
120	Nitrate of soda	Fall	1333	1728	2045	1755	1677	2156	1562	1306	2810	1819
120	Nitrate of soda	Spring	1298	1611	2049	1985	1766	2774	1547	1801	3371	2022
120	Ammonium nitrate	Fall	1350	1649	1974	1843	1623	2261	1509	1058	3190	1829
120	Ammonium nitrate	Spring	1249	1663	1933	1883	1620	2579	1476	1651	3436	1943
120	Anhydrous ammonia	Fall	1304	1510	1940	1769	1579*	1967	1595	1398	2991	1784
120	Anhydrous ammonia	Spring	1243	1627	1953	2025	1767*	2223	1598	1869	3451	1974

* Cyanamid used in place of anhydrous ammonia.

[1] Soil types: 424—Forestdale silty clay loams.
322—Sharkey clay.
436—Dundee fine sandy loam.
456—Bosket fine sandy loam.

to time of application. At one location there was an advantage for fall-applied nitrogen and on one site, W-322, a slight advantage for spring applied nitrogen. It should be pointed out that precipitation was below normal during the winter of 1955-56. In 1957 both tests showed an advantage for spring-applied nitrogen. The inefficiency of fall-applied nitrogen for the 1957 crop was attributed to heavy weed growth on location S-436. On location W-322 the nitrogen was apparently lost by other means. The 1960 results were similar to those obtained in 1957. These results show spring application of nitrogen was better than fall application. Winter weeds on the lighter soils and loss, possibly due to denitrification, on the heavy soils appear to be the main reasons for the advantage for spring application.

Regardless of what accounts for the reduced efficiency of nitrogen applied in the fall, the results indicate the practice is not satisfactory.

Placement of Nitrogen

The 5-year results showing the influence of placement of nitrogen, at varying distances from the drill, on the yield of cotton are reported in Table 13. The average yields show no differences occurred as a result of the placement treatments. There were plant responses which conceivably could affect yields under different soil or weather conditions. When the nitrogen was placed 20 inches from the drill there was a lag averaging 5 to 6 weeks before the cotton plants picked up the applied nitrogen. When the nitrogen was placed 13 inches from the drill the lag amounted to about 3 to 4 weeks after planting. There was no difference in the effect of anhydrous ammonia and ammonium nitrate on yields or the response to placement. Therefore, the yields were reported as averages of the two sources.

The 6-year results of a test which evaluated depth of placement of nitrogen are reported in Table 14. In this experiment the depth of placement was measured from level ground. The yields show an increase as the nitrogen application became deeper. There was no difference between anhydrous am-

Table 13. Influence of placement of nitrogen at varying distances from the drill on the yield of cotton.

Placement	1949	1950	1951	1952	1953	Average
	Pounds of seed cotton per acre					
No treatment	1381	1482	1092	1485	1605	1409
Directly beneath seed	2038	1938	1609	1948	2410	1989
6 inches to one side of seed drill	2042	2033	1738	2057	2462	2066
In two bands 6 inches from seed drill	2008	2048	1597	1985	2371	2002
13 inches from seed drill	1998	2105	1603	2051	2379	2027
20 inches from seed drill	2012	2027	1567	1988	2327	1984

Soil type—Dubbs silt loam.
Nitrogen source—Each yield figure is an average of plots receiving anhydrous ammonia and ammonium nitrate.
Rate of nitrogen—60 pounds of N per acre.
Depth of placement—6 to 9 inches deep.
Time of application—one to three weeks before planting.

Table 14. Effect of depth of placement of nitrogen on the yield of cotton.

Depth of placement	1949	1950	1951	1952	1953	1954	Avg.
	Pounds of seed cotton per acre						
No treatment	1464	1601	1206	1586	1795	1259	1485
4 inches	2128	1856	1550	2084	2373	1337	1888
6 inches	2209	2002	1580	2229	2408	1315	1957
8 inches	2333	2086	1585	2231	2464	1435	2022
10 inches	2336	2084	1739	2239	2583	1444	2071

Soil type—Bosket loam.
Rate of nitrogen—60 pounds of N per acre.
Source of nitrogen—Each yield figure is an average of anhydrous ammonia and ammonium nitrate treated plots.
Time of application—Before planting.

monia and ammonium nitrate in their effect on yields. Again the yields from sources were averaged for reporting purposes.

In this experiment it could not be determined whether the response to depth of application was due entirely to the placement of nitrogen or whether some of the increased yields may have been attributable to the effect of the chisel used in making the deep application. In an attempt to eliminate the effect of the chisel another experiment was initiated in 1955. In this experiment the nitrogen was applied at 10, 14, and 18 inches deep and companion plots were treated at the same depth with the chisel but the nitrogen application was made 2 to 3 inches deep. The results(*Table 15*) indicate some advantage for placing nitrogen 10 to 14 inches deep and the response is not attributable to the effect of the chisel.

Phosphorus and Potash for Cotton

Prior to 1949 several experiments were conducted at the Delta Station and on outlying fields where the influence of phosphorus and potash on cotton production was measured. Most of these experiments showed no benefit. However, there were some exceptions. Most of these experiments were also conducted on the best soils of the Delta. In 1949 a testing program was initiated to study the response to phosphorus and potash on a cross section of Delta soils. Mississippi Agricultural Experiment Station survey personnel and the Mississippi Agricultural Extension Service cooperated in this project. Table 16 reports the results of most of these tests. Several experiments were abandoned and the data from others were discarded because of extreme experimental error. The soil types have been divided into 5 groups based on similar physical characteristics. The yields are reported on 17 locations on Dundee soils. These varied from very fine sandy loam to silty clay loam. There were 7 of the tests areas where significant response or a strong indication of significant response to phosphorus and/or potash was measured. There were 10 locations where no significant response was measured. On the 10 locations the highest rate of phosphorus and potash produced slightly higher actual yields than the average of the other treatments.

There was considerable variation in yield on the Collins soil and the response to nitrogen was low. Two of the 4 locations produced higher yields when phosphor-

Table 15. Effect of varying depth of applying of nitrogen on cotton yields, Delta Station, 1955-1960.

Treatment	1955	1956	1957	1958	1959	1960	6-Yr. avg.
	Pounds of seed cotton per acre						
No treatment	2070	1228	1561	1530	1188	1329	1484
Subsoiled, 10 inches—no nitrogen	2037	1457	1733	1556	1161	1629	1596
Subsoiled, 14 inches—no nitrogen	1928	1497	1312	1741	1230	1498	1534
Subsoiled, 18 inches—no nitrogen	1877	1529	1269	1500	1164	1430	1462
No subsoiling, nitrogen surface applied	2301	1671	2300	2302	2652	2003	2205
Subsoiled 10 inches, nitrogen surface applied	2634	1639	2338	2400	2718	1875	2267
Subsoiled 14 inches, nitrogen surface applied	2893	1853	1701	2305	3047	2163	2327
Subsoiled 18 inches, nitrogen surface applied	2614	1750	1679	2070	2674	2157	2158
Subsoiled 10 inches nitrogen 10 inches deep	2759	1790	2327	2560	2819	1825	2347
Subsoiled 14 inches nitrogen 14 inches deep	2869	1845	1809	2703	2920	2059	2368
Subsoiled 18 inches nitrogen 18 inches deep	2747	1881	1717	2501	2824	1875	2258

Soil type—Dubbs silt loam.
Nitrogen source—Ammonium nitrate.
Rate of nitrogen—60 pounds of N per acre.

us and potash were applied at the 80-pound level.

There was no response to phosphorus or potash on Bosket, Dubbs, Sharkey, Alligator, Forestdale, and Brittain soils.

The data reported in Table 16 gives some indication of productive capacity of various Delta soils. Highest yields were obtained with the better drained Bosket and Dubbs soil and lowest yields were produced on Sharkey and Alligator soils.

After 1950 most of the experiments were abandoned and those which were continued were altered. The rate of nitrogen used was increased and in some cases higher rates of phosphorus and potash were applied. The results of these experiments varied little from the 1949 and 1950 results. All of these locations were selected without regard to the results of soil analysis. No effort was made to select areas with any specified level of phosphorus and potash. In 1956 a new series of experiments was initiated to make further study on phosphorus and potash. All of these sites were selected by use of soil test information. In every case the chemical test suggested the likelihood of a response. All of the experiments with any specific level of phosphorus and potash. In 1956 a new series of experiments was initiated to make further study on phosphorus and potash. All of these sites were selected by use of soil test information. In every case the chemical test suggested the likelihood of a response. All of the experiments of 3 years but due to changes in the owners' planting plans only a few were conducted for more than one year. The results are shown in Table 17. There were 10 locations where phosphorus was varied. In 4 tests a response to phosphorus was indicated and no response was indicated in 6 tests. There were 12 locations in which

Table 16. The influence of nitrogen, phosphorus, and potassium on cotton production on different soils, 1949 and 1950.

Treatment	Dundee soils				Bosket & Dubbs		Collins[2]	
	Average of 7 locations[1]		Average of 10 locations		Average of 12 locations		Average of 4 locations	
	Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase
	Pounds of seed cotton per acre							
0-0-0	1156	.....	1085	.....	1678	.....	1436	.....
60-0-0	1466	310	1630	545	2102	424	1679	243
60-0-40	1861	705	1630	545	2138	460	1701	265
60-40-0	1582	426	1652	567	2139	461	1691	255
60-40-40	1776	620	1674	589	2141	463	1785	349
60-80-80	1941	785	1724	639	2143	465	2073	637

Treatment	Sharkey and Alligator		Forestdale and Brittain	
	Average 10 locations		Average 5 locations	
	Yield	Increase	Yield	Increase
0-0-0	821	.....	924	.....
60-0-0	1375	554	1524	600
60-0-40	1356	535	1447	523
60-40-0	1412	591	1460	536
60-40-40	1393	572	1455	531
60-80-80	1404	583	1562	638

[1] Seven locations showed a significant response or strongly indicated a response to potassium and five locations responded to phosphorus.

[2] Two locations showed a response to phosphorus and potash.
All treatments were made before planting.

Table 17. The influence of nitrogen, phosphorus, potash and lime on the yield of cotton.

Treatment	Soil type and number of years												
	435 1-Yr.	435 1-Yr.	435 1-Yr.	435 1-Yr.	435 1-Yr.	435 2-Yr.	435 1-Yr.	435 1-Yr.	436 3-Yr.	446 1-Yr.	535 1-Yr.	425 2-Yr.	456 1-Yr.
	Pounds of seed cotton per acre												
0-0-0	1610	784	956	1152	2135	1687	.....	.....	1247	2544	1164	1028	1501
N-O-K	1360	676	1084	1530	1802	1769	.....	.....	1628	2616	1513	1556	2718
N-40-K	1332	825	1182	1523	1853	1780	.....	.....	1701	2757	1691	1603	2556
N-80-K	1387	830	1139	1697	1820	1819	.....	.....	1736	2829	1535	1644	2676
N-120-K	1471	844	1195	1707	1793	1779	.....	.....	1821	2915	1595	1551	.....
											2-Yr.		
N-P-O	1351	868	1057	1387	2163	1935	818	1343	1447	2648	1125	1642	2307
N-P-40	1339	911	1154	1555	2008	1923	784	1234	1706	2586	1315	1613	2474
N-P-80	1439	820	1201	1690	2107	1897	784	1334	1741	2665	1384	1695	2390
N-P-120	1538	920	1161	1748	2016	1981	732	1227	1780	2696	1477	1703	.....
No lime	1108	.....	1034	.....	.....	1729	693	1344	.....	.....	1198	1566	2772
Lime	1205	.....	1025	.....	.....	1799	759	1454	.....	.....	1205	1829	2874

Soil types: 435—Dundee silt loam.
436—Dundee fine sandy loam.
446—Dubbs fine sandy loam.
425—Forestdale silt loam.
535—Collins silt loam.
456—Bosket fine sandy loam.

When phosphorus was varied 120 pounds of N and K_2O per acre were applied.
When potassium was varied 120 pounds of N and P_2O_5 per acre were applied
All treatments were made before planting.

potash was tested. Four tests showed a response to potash and 8 tests showed no response.

In an experiment at the Delta Station which was started in 1947 annual treatments of phosphorus and potash have been made and the effect on the cotton yields determined. The rates of application of nitrogen, phosphorus, and potash have been changed but in no case has phosphorus been applied where treatments indicated no phosphorus nor has potash been applied where the treatment required no potash. Because of the change in rates of application only the last 5 years are reported in Table 18. The 5-year average results show no significant response to the use of phosphorus and potash. In this experiment a significant response to phosphorus was measured in 1954 at the higher levels of nitrogen and when potash was applied. No explanation can be suggested why a response was measured in one year and not in other years.

Table 18. Rates of nitrogen, phosphorus, and potash for cotton production, Delta Station.

Treatment	1954	1955	1956	1957	1958	1959	6-Yr. avg.
				Pounds of seed cotton per acre			
60-0-0	1604	2652	1432	2171	2311	2542	2119
60-40-0	1711	3012	1509	2328	2525	2703	2298
60-80-0	1693	2887	1503	2340	2450	2700	2262
60-0-80	1803	2753	1684	2228	2649	2670	2298
60-40-80	1553	2979	1592	2331	2569	2732	2293
60-80-80	1678	2934	1485	2426	2450	2774	2290
90-0-0	1589	2970	1622	2456	3020	2899	2426
90-40-0	1699	3157	1726	2328	3309	3148	2561
90-80-0	1871	3089	1758	2370	3243	3086	2570
90-0-80	1648	2931	1654	2177	2934	2925	2378
90-40-80	1708	2952	1553	2189	2819	3009	2372
90-80-80	1841	3119	1821	2156	2994	3127	2510
120-0-0	1860	3166	1821	2269	3267	3252	2606
120-40-0	1714	3163	1559	2302	2851	3020	2435
120-80-0	1628	3070	1515	2462	3107	3119	2484
120-0-80	1586	3062	1518	2441	3178	3065	2475
120-40-80	1972	3175	1803	2302	3015	3279	2591
120-80-80	1821	3142	1636	2225	3101	3080	2501
				Rates of Phosphorus (average)			
0	1682	2899	1642	2084	2893	2893	2349
40	1726	3077	1664	2057	2848	2982	2392
80	1755	3041	1620	2095	2891	2982	2397
				Rates of Potash (average)			
0	1707	3018	1605	2106	2898	2939	2379
80	1734	2982	1639	2052	2857	2963	2371

Soil type—Bosket silt loam.
Time of application—Before planting.
Source of N—Anhydrous ammonia.
Source of P—Superphosphate.
Source of K—Muriate of potash.

Table 19. Effect of lime and magnesium on the yield of cotton on different soils 1949 and 1950.

Treatment	Soil types				
	Dundee soils 6 locations	Bosket & Dubbs 7 locations	Collins	Sharkey & Alligator 3 locations	Forestdale & Brittain 3 locations
	Pounds of seed cotton per acre				
60-40-40	1749	2189	....	1428	1651
60-40-40 + Magnesium	1827	2120	....	1372	1741
	10 locations	8 locations	3 locations[1]	7 locations	3 locations[2]
60-40-40	1784	2208	1358	1232	1445
60-40-40 + Lime	1791	2168	1458	1233	1557

[1] One test on collins silt loam showed a significant response to lime.
[2] One test on Forestdale showed a significant response to lime.
All treatments were made before planting.

Lime and Magnesium for Cotton

In the series of experiments conducted in 1949 and 1950 studying response to phosphorus and potash, lime and magnesium treatments were included in many cases. Magnesium was applied at the rate of 50 pounds of MgO per acre with magnesium sulphate as the source. Lime was applied at a rate designed to raise the pH to 6.5. The basic treatment involved where lime and magnesium were used was 60 pounds of nitrogen, 40 pounds of P_2O_5, and 40 pounds of K_2O. Table 19 lists the yields of 19 experiments where magnesium was used and 33 experiments where lime was used. In no case was there a response to magnesium. There were two experiments which showed a significant response to lime.

In the series of experiments begun in 1956, where phosphorus and potash were studied on those sites which had a pH of 5.2 or lower a lime treatment was added. In these experiments lime was added to plots which received 120 pounds of nitrogen with no phosphorus or potash. There were 8 locations in which lime was used. One site on a Forestdale soil showed a significant response to lime in each of the 2 years of the test. The increased earliness of the cotton at this location was more striking than the increase in yield. At 5 other test areas the yield was slightly higher where lime was used but the increase was not statistically significant and observation during the growing season and at harvest time suggested little or no response to lime treatment. In none of the 5 tests was there any increased earliness which was attributable to the lime treatment.

Sulfur for Cotton.—During recent years numerous small areas of cot-

Table 19A. Effect of a minor element mixture on the yield of cotton, Delta Station.

Treatment	1954	1955
	Pounds of seed cotton per acre	
120-80-80	1821	.....
120-80-80 + Minor Elements	1628	.....
75 pounds of N per acre	.....	2824
75 pounds of N + Minor Elements	.....	2819
400 lb. 6-24-24 + 51 pounds of N	.....	2955
400 lb. 6-24-24 + 51 pounds of N + Minor Elements	.....	2726

Minor element mixture consisted of copper, zinc, boron, and manganese.
Soil type—Bosket loam.
Time of treatment—Before planting.

ton have exhibited symptoms of sulfur deficiency in the Delta. In most cases the deficiencies have been associated with soils having a very high sand content. Frequently, heavy cuts on graded fields also show sulfur deficiency symptoms. These symptoms are characterized by yellowing of the leaves especially the younger leaves. Usually a darker color prevails along the leaf veins. The yellow color is somewhat brighter in appearance than is usually associated with a nitrogen deficiency although the general appearance is similar.

There are no yield data available showing response of cotton to sulfur in the Delta. There have been several field trials and it has been demonstrated that 150 pounds of ammonium sulfate or 200 pounds of gypsum per acre will correct the deficiency indicated by plant appearance. Where the deficiency needs to be corrected in a growing crop, ammonium sulfate is considerably quicker acting than gypsum. It is not intended to suggest that the sources and rates of sulfur mentioned are the proper treatments. More field work will be necessary for this determination. It is suggested that it has been demonstrated that ammonium sulfate or gypsum at the rates mentioned will alleviate the problem.

Minor Elements for Cotton

Very little work has been done with minor elements in the Delta. During the period 1939-1943 various minor elements were tried but no response was measured. In 1954 a minor element mixture consisting of copper, zinc, boron and manganese was added to a base treatment of nitrogen phosphorus, and potash. In 1955 minor elements were tried with nitrogen alone and with nitrogen, phosphorus, and potash. The yields are listed in Table 19A. They show no benefit for minor elements.

Corn Fertilization

Sources of Nitrogen for Corn

In the nitrogen sources experiment described in the cotton section a rotation consisting of cotton, corn and oats was used. Table 20 shows the corn yields obtained where the different nitrogen sources were applied. In this experiment all materials were applied at the rate of 30 pounds of nitrogen per acre

through 1951. In 1952 the rate of application was increased to 120 pounds per acre for corn. In addition to this change anhydrous ammonia was substituted for the mixture of cottonseed meal and sodium nitrate.

The 37-year average yields show little difference between sources except that cottonseed meal was slightly inferior to other materials. The planting date in this experiment varied from the first week in April until June 1, but in most years the corn was planted between April 25 and May 5.

Additional sources comparisons for corn have been made and the results showed very little difference among the sources. In most cases the rate of application was constant. In 1950, an experiment was initiated to compare anhydrous ammonia, ammonium nitrate, sodium nitrate, and cyanamid at rates of 60, 90, 120, 150, and 180 pounds of nitrogen per acre. In this experiment all nitrogen materials were applied at a depth of 6 to 8 inches before planting. Dixie 22 was the variety planted.

The 9-year results show no interaction between sources and rates of nitrogen in their effect on yield. When cyanamid was applied at rates of 120 pounds per acre or more there was considerable burning of the plants during early growth and the effect was noticeable for 6 to 7 weeks. This early toxic effect apparently did not influence the yield. Since there was no interaction between sources and rates the results of the 90-pound rate only is reported in Table 21. This rate was selected because it was slightly below the maximum rate of nitrogen which increased yields. The average results of the 4 sources show no significant differences among them.

Rates of Nitrogen for Corn

In 1921, an experiment was begun which compared nitrogen rates varying in 7-1/2 pound increments up to 45 pounds of nitrogen per acre. Nitrate of soda was used as the source of nitrogen and was applied before planting. The 37-year results of this experiment are reported in Table 22. The average yields show that the yield of corn increased as the rate of nitrogen

Table 20. Effect of sources of nitrogen on the yield of corn, Delta Station.

Treatment	1921-1951 average	1952-1957 average	37-Year average
		Bushels of corn per acre	
No Nitrogen	24.5	25.1	24.6
Sodium nitrate	41.6	59.5	44.5
Ammonium nitrate	43.2	62.3	46.4
Ammonium sulphate	39.8	61.4	43.3
Cyanamid	39.8	62.6	43.5
Cotton-seed meal	35.2	40.8	36.1
One-half Cottonseed meal and one-half sodium nitrate	36.3	.....	.....
Anhydrous ammonia	.....	63.8	.....

Soil type—Bosket silt loam predominates with small areas of Dubbs included.
Rate of nitrogen—30 pounds per acre 1921 through 1951.
120 pounds per acre 1952 through 1957.
Time of application—one to three weeks before planting.

Table 21. Yield of corn with different sources of nitrogen, Delta Station, 1950-1959.

Nitrogen source	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	10-Yr. avg
	Bushels of corn per acre										
No nitrogen	38.0	25.6	21.7	47.7	26.4	50.0	35.6	37.1	17.2	16.2	31.6
Cyanamid	91.6	55.0	54.2	87.4	56.4	95.6	84.1	74.0	68.9	73.5	74.1
Ammonium nitrate	83.0	58.2	53.9	85.7	60.0	97.0	85.2	68.0	70.2	75.7	73.7
Anhydrous ammonia	87.6	59.9	54.3	82.3	63.3	88.5	87.8	63.6	62.5	68.8	71.9
Sodium nitrate	86.2	58.6	47.3	77.5	51.0	99.4	88.1	61.7	66.3	68.6	70.5

Soil type—Bosket silt loam.
Rate of nitrogen—90 pounds of N per acre.
Time of application—One to three weeks before planting.

increased with considerable variation in yield among years.

As a supplement to the experiment described in the preceding paragraph an experiment was started in 1951 beginning with 45 pounds of nitrogen per acre and increasing to 120 pounds per acre in 15-pound increments. Table 23 reports the 7-year average yields of this experiment. The highest yields were produced when 120 pounds of nitrogen per acre were applied but the increase over 105 pounds was only 1.8 bushels per acre.

In a sources and rates experiment where the rate of application varied from 60 to 180 pounds of nitrogen per acre in 30-pound increments the yield was not increased by exceeding 120 pounds of nitrogen per acre. The results are shown in Table 24. There were consistent increases up to that level. In this test lodging increased as the rate of nitrogen increased and became quite severe at the rate of 150 and 180 pounds of nitrogen per acre.

A nitrogen rates experiment was conducted on a Sharkey clay soil from 1953 through 1958. Ammonium nitrate was used as the nitrogen source and was applied near planting time either just before or within a very short time after planting. It was necessary to abandon the experiment in 1954. Table 25 shows the 5-year yields of corn where the varying rates of nitrogen were applied. Tremendous variation in the yield level resulted from varying weather conditions among years. The corn yields increased as the rate of nitrogen increased up to 120 pounds per acre but showed no benefit from rates exceeding 120 pounds. Although it was not consistent there was an indication that yields might have been slightly reduced at the highest levels of nitrogen application in 1955 and 1956. This could have been associated with the greater weed growth on the high nitrogen plots.

Time of Applying Nitrogen for Corn

An experiment was begun in 1951 to compare pre-plant, split-application, and side dressing application of nitrogen for corn. The experiment was located on a Bosket silt loam soil. Anhydrous ammonia and ammonium nitrate were used as sources and were applied 6 to 8 inches deep at the rate of 120 pounds of nitrogen per acre. The variety used was Dixie 22. Table 26 lists the yields of corn from the two sources applied at the three times. The highest yields were produced when the nitrogen was applied prior to planting and no difference existed between anhydrous

Table 22. The influence of rates of nitrogen on the yield of corn, Delta Branch Experiment Station, 1921-1957.

Year	No nitrogen	Pounds of nitrogen per acre 7.5	15.0	22.5	30.0	37.5	45.0
			Yield in bushels of corn per acre				
1921	40.5	41.4	43.2	44.5	46.0	44.8	44.0
1922	32.7	34.4	38.4	45.1	48.2	54.8	56.4
1923	30.3	31.7	35.1	42.9	44.2	43.7	50.4
1924	26.3	29.5	32.2	39.2	40.2	42.3	42.4
1925	26.1	29.1	31.2	32.5	30.4	29.5	28.9
1926	26.3	30.2	34.9	39.2	43.2	47.5	46.0
1927	30.9	36.4	46.0	50.3	62.8	62.5	61.7
1928	31.6	40.3	49.3	55.9	66.5	73.9	73.7
1929	12.6	14.5	21.1	22.8	30.9	32.6	33.4
1930	11.9	13.1	16.7	20.7	24.6	26.9	27.3
1931	45.3	62.1	63.8	59.7	55.5	52.5	55.7
1932	14.3	15.4	21.7	25.1	35.3	38.1	39.9
1933	15.3	14.2	16.5	18.4	22.4	25.9	28.4
1934	12.4	14.2	19.3	23.0	27.0	28.8	28.9
1935	11.5	12.2	18.1	22.4	29.9	35.8	36.5
1936	10.0	12.8	13.5	15.2	19.0	21.1	20.4
1937	11.1	16.1	20.2	27.5	33.4	33.7	35.9
1938	14.5	15.4	21.4	23.3	32.5	40.5	44.3
1939	11.2	14.8	17.7	21.8	25.9	28.7	30.5
1940	47.9	49.3	52.9	57.9	61.4	63.8	67.2
1941	30.9	32.4	39.2	41.7	43.5	45.8	50.3
1942	29.1	34.4	43.2	47.4	54.3	57.9	62.5
1943	15.4	20.1	25.2	30.6	34.6	33.9	38.9
1944	15.6	15.7	16.9	23.1	24.3	23.9	22.1
1945	43.2	48.9	55.8	65.6	67.1	74.6	77.8
1946	39.2	39.6	44.9	55.1	62.3	67.3	72.1
1947	20.1	24.0	28.8	32.6	39.1	43.8	48.5
1948	22.9	23.7	31.7	33.6	41.3	44.8	48.1
1949	35.8	40.0	45.4	54.4	62.5	68.5	74.0
1950	27.7	30.6	39.6	46.5	50.4	59.8	63.7
1951	22.5	23.2	27.9	32.8	33.8	38.5	45.5
1952	21.4	25.2	30.9	34.2	41.6	49.1	51.2
1953	20.5	24.9	32.1	36.7	40.4	42.3	46.9
1954	23.7	30.8	35.0	41.4	43.6	40.2	44.4
1955	16.6	17.5	23.0	26.1	30.7	34.2	37.1
1956	33.4	44.5	42.6	48.5	50.0	53.2	55.6
1957	35.0	39.7	45.3	45.3	53.5	59.7	60.5
Average	24.8	28.1	33.0	37.4	42.0	45.0	47.3

Soil type—Bosket silt loam.
Source of nitrogen—Sodium nitrate.

ammonia and ammonium nitrate. When the nitrogen was applied as a side dressing there was a slight advantage for ammonium nitrate over anhydrous ammonia. In 5 of the 7 years, side dressing with ammonium nitrate produced yields significantly higher than anhydrous ammonia. In most cases ammonium nitrate applied as a side dressing took effect somewhat sooner than anhydrous ammonia. It should be pointed out however, that the ammonium nitrate was applied 6 to 8 inches deep in the same manner as anhydrous ammonia.

Placement of Nitrogen on Corn

An experiment was initiated in

Table 23. The effect of rates of nitrogen on corn production, Delta Station, 1959-1958.

Pounds of N per acre	1951	1952	1953	1954	1955	1956	1957	7-Yr. average
Planting date	5/10	5/10	5/23	4/19	4/30	4/21	5/31	
				Bushels per acre				
0	15.9	26.6	16.3	21.6	26.4	26.3	36.9	24.3
45	44.2	55.0	35.3	48.6	49.5	40.3	66.7	48.5
60	54.5	64.5	38.0	67.8	63.6	46.4	70.2	57.9
75	63.6	63.9	47.0	66.6	68.7	52.8	77.6	62.9
90	71.8	67.4	42.4	65.1	68.1	55.5	80.0	64.3
105	75.5	71.2	46.8	70.5	72.3	58.0	82.1	68.1
120	81.1	71.9	45.9	68.4	83.9	58.5	79.8	69.9

Soil type—Bosket silt loam.
Nitrogen source—Anhydrous ammonia.
Date applied—one to three weeks before planting.
Variety—Dixie 22.

Table 24. The effect of rates of nitrogen on the yield of corn, Delta Station, 1950-1960.

Pounds of N per acre	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	11-Yr avg.
						Bushels of corn per acre						
No nitrogen	38.0	25.6	21.7	47.7	26.4	50.0	35.6	37.1	17.2	16.2	17.3	30.3
60	74.0	47.1	44.4	80.4	56.7	85.3	69.7	63.0	62.3	55.6	44.8	62.1
90	87.1	57.9	52.4	83.2	57.7	95.1	86.3	66.8	67.0	71.7	54.9	70.9
120	97.5	68.7	53.5	84.4	58.1	102.8	91.5	72.1	85.0	80.8	62.0	77.9
150	98.1	67.4	51.1	73.3	52.1	101.2	85.3	77.2	86.5	82.1	54.7	75.4
180	99.5	54.4	49.9	80.5	61.3	94.4	93.6	74.9	84.1	71.2	60.6	74.9

Soil type—Bosket silt loam.
Nitrogen source—Each yield represents an average of plots receiving cyanamid, ammonium nitrate, anhydrous ammonia and sodium nitrate.
Time of application—Before planting.
Corn spacing—1 plant per foot of row.

Table 25. Effect of rates of nitrogen on corn production on Sharkey Clay, Delta Station, 1953-1958.

Pounds of N per acre	1953	1955	1956	1957	1958	5-Yr. avg.
			Bushels of corn per acre			
0	12.4	65.5	18.8	7.2	8.7	22.5
60	21.8	84.1	48.5	35.3	18.9	41.7
90	19.8	80.7	43.5	40.3	27.4	42.3
120	17.3	90.7	50.9	47.6	31.7	47.6
150	21.4	89.1	41.3	54.6	36.7	48.6
180	20.1	86.7	44.1	55.5	30.7	47.4

Nitrogen source—Ammonium nitrate.
Variety—Dixie 22.

1949 to study the effect of nitrogen at varying distances from the seed drill on the yield of corn. The test was located on a Bosket silt loam soil and anhydrous ammonia and ammonium nitrate were used as sources. Each material was applied before planting, 6 to 9 inches deep, at the rate of 120 pounds of nitrogen per acre. A poor stand caused abandonment of the experiment in 1953. The 5-year results of this test are shown in Table 27. There were no significant differences in yield which were attributable to placement. The average yield when the nitrogen was placed 20 inches from the drill was slightly lower than the other treatments. It was observed that 3 to 5 weeks elapsed each year before a color change in the corn indicated that the nitrogen was being taken up when placed 20 inches from the drill. In this test the average yield of the plots treated with ammoni-

Table 26. Effect of time of applying anhydrous ammonia and ammonium nitrate on the yield of corn.

Treatment	1951	1952	1953	1954	1956	1957	1958	Average
	Bushels of corn per acre							
No nitrogen	19.6	14.4	23.3	9.5	34.1	36.1	17.2	22.0
Anhydrous ammonia								
preplant	68.6	69.5	73.1	79.4	99.6	69.7	85.9	78.0
split	70.6	69.3	64.4	77.3	94.1	60.2	74.2	72.9
side dress	65.4	66.7	64.9	77.1	93.4	55.9	74.8	71.2
Ammonium nitrate								
preplant	67.0	72.7	73.3	82.0	104.0	67.8	83.3	78.6
split	73.4	66.8	70.4	82.3	97.2	63.5	77.3	75.8
side dress	76.5	69.2	72.8	82.4	96.8	62.8	81.5	77.4

Soil type—Bosket silt loam.
Rate of nitrogen—120 pounds of N per acre.
Depth of application—6 to 8 inches deep.

Table 27. Influence of placement of nitrogen at varying distances from the seed drill on the yield of corn.

Placement	1949	1950	1951	1952	1954*	Avg.
	Bushels of corn per acre					
No treatment	50.7	35.6	13.0	13.5	18.1	26.2
Directly beneath seed	89.7	94.8	67.8	50.7	73.3	75.3
6 inches to one side of seed	90.0	94.1	68.4	48.8	72.0	74.7
In two bands 6 inches from seed drill	90.3	96.0	67.2	49.4	78.5	76.3
20 inches from seed drill	87.5	93.6	66.8	45.9	76.8	74.1

Soil type—Bosket silt loam.
Nitrogen source—Each yield is an average of plots receiving anhydrous ammonia and ammonium nitrate.
Rate of nitrogen—120 pounds of N per acre.
Depth of placement—6 to 9 inches deep.
Time of application—One to three weeks before planting.
*Test was abandoned in 1953 due to poor stand.

um nitrate was 90.7 bushels per acre and the yield of the plots treated with anhydrous ammonia was 88 bushels per acre.

A test designed to measure the effect of varying depths of placement of nitrogen on the yield of corn was conducted from 1951-1954. Previous work had shown an advantage for placing nitrogen 10 to 12 inches deep when compared with placement 2 to 3 inches deep but no intermediate depths were used. This experiment was located on a Bosket loam. Anhydrous ammonia and ammonium nitrate were used as sources and were applied at the rate of 120 pounds of N per acre, before planting, 6 to 8 inches to the side of the seed drill. The nitrogen was placed 4, 6, 8, and 10 inches deep. The results are listed in Table 28. The results show a slight increase in yield to a depth of 8 inches. This was true in 3 of the 4 years in which the test was conducted. There was no indication that there was a lag in the nitrogen being taken up from the deeper treatments.

Phosphorus and Potash for Corn. In 1949 and 1950 approximately 45 experiments were conducted with corn in which the effect of phosphorus and potash was studied. Except for the check plots all plots received a uniform treatment of 120 pounds of nitrogen per acre. These experiments were scattered throughout the Delta area. Superphosphate was used as the source of phosphorus and muriate of potash supplied the potassium. In all cases the fertilizer was applied before planting. Table 29 lists the results of 31 experiments with the yields averaged for similar soils. Other experiments which were conducted during this same time are not included in the table because of lack of uniformity within the plot area or because only one experiment was conducted on a particular soil type. In all of the tests conducted there was only one experiment where a response to phosphorus was obtained in harvested yields. There were no tests where a response to potash occurred. There were 3 or 4 locations on Bosket and Dundee soil where phosphorus increased the rate of seedling growth but yields were not affected.

In addition to the tests which were conducted in 1949 and 1950 several other one-year experiments

Table 28. Effect of depth of placement of nitrogen on the yield of corn.

Depth of placement	1951	1952	1953	1954	Average
			Bushels of corn per acre		
No treatment	31.6	17.5	41.4	24.6	28.8
4 inches	57.8	56.4	84.9	65.7	66.2
6 inches	66.3	61.8	82.8	68.3	69.8
8 inches	69.2	63.1	84.8	71.5	72.1
10 inches	71.2	61.7	85.2	67.8	71.5

Soil type—Bosket loam.
Rate of nitrogen—120 pounds of N per acre.
Source of nitrogen—Each yield figure is an average of anhydrous ammonia and ammonium nitrate treated plots.

have been run since that time. The results have been similar with no response to phosphorus and potash indicated by harvested yields.

Lime and Magnesium for Corn

In the experiments conducted in 1949 and 1950 where phosphorus and potash were studied, treatments were added to measure the effect of lime and magnesium. In each case the basic treatment was 120 pounds of nitrogen, 40 pounds of P_2O_5, and 40 pounds of K_2O per acre. Magnesium was applied at the rate of 50 pounds of MgO per acre with magnesium sulphate used as the source. Table 30 shows the yields of corn in 12 experiments where magnesium was added and 22 experiments where agricultural lime was added. The lime was added at a rate calculated to bring the pH of the soil to 6.5. In no case was there a significant response to the addition of lime or magnesium.

Rates of Nitrogen for Corn Interplanted With Soybeans

An experiment was begun in 1950 to study the effect of varying rates of nitrogen on the yield of corn with and without soybeans interplanted. There were 2 years when the test was not planted and 3 years when the stand of soybeans was so poor that the yields were not reported. Table 31 lists the corn yields with and without soybeans at the varying levels of nitrogen for 5 years between 1950 and 1960.

In this test anhydrous ammonia was used as the source of nitrogen and was applied before planting. Ogden soybeans were planted in 1950 and Lee in the other years reported. The soybeans were harvested in 1950 only and averaged 10 bushels per acre with no difference among nitrogen rates. In the other years the soybeans were not harvested but yield estimates indicated a production of 10 to 12 bushels per acre with no difference among nitrogen rates. In 1958 the yield of corn was reduced at all levels of nitrogen by the soybeans. In 1959 and 1960 the yield of corn was increased by the interplanted soybeans on the unfertilized plots and on 60- and 90-pound-nitrogen treatments.

The average yields for the 5 years reported show very little difference in yields between corn with soybeans interplanted and corn without soybeans.

Table 30. Effect of lime and magnesium on the yield of corn on different soils.

Treatment	Dundee soils 3 locations	Bosket & Dubbs 2 locations	Collins	Sharkey & Alligator 4 locations	Forestdale & Brittain 3 locations
			Bushels of corn per acre		
120-40-40	76.4	72.5	.....	53.3	55.5
120-40-40 + MgO	73.4	68.7	.....	54.4	55.9
	4 locations	4 locations	2 locations	6 locations	6 locations
120-40-40	71.3	76.2	67.9	51.0	62.9
120-40-40 + lime	71.8	73.2	68.1	52.9	63.6

All treatments were made before planting.

Table 29. Nitrogen, phosphorus, and potassium for corn production on different soil types, 1949 and 1950.

	Dundee				Bosket & Dubbs		Collins		Sharkey & Alligator		Forestdale & Brittain	
Treatment	6-Test average yield	increase	One-test* yield	increase	7-Test average yields	increase	3-Test average yield	increase	7-Test average yield	increase	7-Test average yield	increase
	Bushels of corn per acre											
0-0-0	35.0	.....	34.4	.....	38.1	.....	39.0	.....	27.2	.....	30.0	.....
120-0-0	69.4	34.4	45.1	10.7	81.6	43.5	79.7	40.7	54.5	27.3	60.6	30.6
120-0-40	68.1	33.1	45.9	11.5	80.6	42.5	78.1	39.1	53.1	25.9	62.3	32.3
120-40-0	67.6	32.6	54.7	20.3	82.9	44.8	77.8	38.8	52.6	25.4	60.4	30.4
120-40-40	68.9	33.9	55.1	20.7	82.5	44.4	77.9	38.9	52.5	25.3	62.9	32.9
120-80-80	65.9	30.9	56.5	22.1	83.5	45.4	75.5	36.5	53.9	26.7	61.5	31.5

*A significant response to phosphorus was obtained in this test.
All treatments were made before planting.

Table 31. The effect of interplanting soybeans in corn on the yield of corn at different nitrogen levels.

	1950		1956		1958		1959		1960		5-Year average	
Pounds of N per acre	No soybeans	With soybeans	No soybeans	With soybeans	No soybeans	With soybeans	No soybeans	With soybeans	No soybeans	With soybeans	No soybeans	With soybeans
	Bushels of corn per acre											
0	52.2	38.6	22.2	22.7	15.9	14.4	16.7	31.6	25.8	40.6	26.6	29.6
60	83.9	74.3	46.5	46.5	41.3	35.5	37.3	41.1	42.4	46.2	50.3	48.7
90	94.5	91.0	57.3	59.9	42.7	36.1	53.0	56.9	46.0	51.5	58.7	59.1
120	100.9	101.3	60.0	67.6	67.4	55.6	72.0	76.0	62.1	60.7	72.5	72.2
150	104.1	101.4	66.0	74.4	67.5	57.6	72.5	69.9	63.4	54.9	74.7	71.6

Soil type—Dubbs silt loam.
Time of nitrogen application—Five to 15 days before planting.