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RESULTS OF FERTILIZER TESTS OF SUGARCANE IN MISSISSIPPI DURING PERIOD 1941-1946

By I. E. STOKES and T. E. ASHLEY[1]

This report briefly summarizes the results of ten fertilizer tests of sugarcane conducted at three locations in Mississippi during the period 1941 to 1946. The tests were designed[2] to determine the general influence of several sources of nitrogen fertilizer mixtures, and methods of application on yields of cane and sirup per acre rather than a critical evaluation of specific fertilizer practices. However, the data furnish some practical information related to the fertilization of sugarcane under certain soil and climatic conditions in Mississippi. Two varieties, Co. 290 and C. P. 29/116, were used in the tests.

Tests were conducted on farms near Meridian and near Laurel, Mississippi, and on the South Mississippi Branch Station at Poplarville, Mississippi. The most uniform areas of soil available at each location were selected for the tests. A sandy phase of the Susquehanna soil series was utilized for the tests at Meridian; the tests at Laurel were conducted on a Ruston Atwood fine sandy loam soil; and Ruston sandy loam soil was used for the tests at Poplarville. In each case the soil was well drained and characterized by a slightly rolling topography.

Uniform agronomic practices of seedbed preparation, methods of planting, and cultivation were utilized at each location. The rate of planting in all of the tests was two stalks. Tests at Poplarville were planted during the fall season, usually about November 1. Tests at Laurel were planted in the spring, about March 15. One of the tests at Meridian, summarized in table 1, was planted in the spring and the other test at that location, summarized in table 2, was planted in the fall.

Standard commercial fertilizer materials were used in all of the tests. Sources of nitrogen are indicated for each test in tables 1 to 6. Phosphoric acid (P_2O_5) was obtained in each case from 20 percent superphosphate. Potash was obtained in each case from muriate of potash.

Each treatment, in the tests, was replicated three times except in the test at Meridian, summarized in table 2, where the treatments were replicated four times. Plots approximately 1/100 acre were utilized in all of the tests.

A uniform method of applying the fertilizer was followed in all tests. Fertilizer materials were applied during March in all treatments. Where two applications were involved, the second application was applied during the latter part of June. Two applications were involved in all of the experiments except some of the treatments in the tests summarized in tables 1 and 6.

Fall planted cane utilized for most of the tests was off-barred during the early part of March. Fertilizer treatments were then applied by hand in narrow bands on the bottom of the off-bar furrows approximately 3 inches from the cane and covered to a depth of approximately 4 inches by harrowing the soil from the middles. The second application was applied in small furrows about

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Table 1. Results of fertilizer tests on Susquehanna soil (sand); Mrs. George P. Hoffmann's Farm, Meridian, Mississippi.[1]
Variety: C. P. 29/116

Source of nitrogen	Pounds of fertilizer per acre		Plant cane (1)			First year stubble (1)			Second year stubble (1)		
			Average acre yield of cane	Yield of sirup		Average acre yield of cane	Yield of sirup		Average acre yield of cane	Yield of sirup	
	N	P_2O_5		Per ton	Per acre		Per ton	Per acre		Per ton	Per acre
			Tons	Gallons	Gallons	Tons	Gallons	Gallons	Tons	Gallons	Gallons
Phosphorus mixed in the soil; Nitrogen applied in one application[2]											
Cyanamid	60	100	15.00	18.5	277	33.70	17.0	573	32.55	19.0	618
	60	0	10.40	18.7	194	25.33	17.3	438	22.59	16.2	366
Nitrate of soda	60	100	20.40	17.3	354	33.18	18.6	617	31.19	15.9	496
	60	0	16.80	18.6	312	26.11	18.3	478	22.30	18.5	413
Ammonuim sulphate	60	100	19.50	18.6	353	34.14	19.5	666	29.86	18.8	561
	60	0	16.80	19.7	331	30.59	18.8	575	29.25	17.4	509
Cottonseed meal	20	100	12.50	17.9	224	28.47	19.1	544	27.02	18.0	486
	40	100	13.80	19.4	268	28.33	19.1	541	29.44	19.4	571
	60	100	14.60	20.7	302	28.44	19.4	552	29.58	18.1	535
	60	0	15.60	17.9	279	30.76	19.9	612	31.82	17.9	570
	80	100	16.00	20.8	333	29.07	19.3	561	30.57	18.4	562
Phosphorus mixed in the soil; Nitrogen applied in two applications[3]											
Ammonium sulphate	60	100	17.50	20.1	151	31.71	19.3	612	33.49	18.2	610
	60	0	15.60	17.9	279	28.11	19.8	557	28.97	18.8	545
Cottonseed meal	60	100	13.70	19.3	264	29.34	19.7	578	31.69	18.4	583
	60	0	13.00	20.5	266	23.18	19.0	440	23.08	17.3	399
Phosphorus and nitrogen applied in a mixture; one application[2]											
Cottonseed meal	20	100	12.20	18.9	231	25.65	19.1	490	27.32	18.3	500
	40	100	12.20	18.4	224	26.26	18.6	488	26.84	19.7	529
	80	100	16.30	19.0	310	29.87	18.7	559	30.77	17.9	551
	0	100	11.10	18.4	204	24.72	19.4	480	26.17	19.7	516
Check	0	0	10.50	19.0	199	26.00	19.9	517	24.13	19.8	478
Difference:											
For P = .05	—	—	4.36	1.23	94	8.63	0.82	183	11.40	0.83	206
For P = .01	—	—	5.79	1.64	125	11.52	1.09	243	15.16	1.11	274

[1] Numbers in parentheses indicate the number of tests.
[2] Applied in March.
[3] 2/3 applied in March and the remainder in June.

Table 2. Results of fertilizer tests on Susquehanna soil (sand); Mrs. George P. Hoffmann's Farm Meridian, Mississippi.[1]
Variety: C. P. 29/116

Pounds of fertilizer per acre			Plant cane (1)			Second year stubble (1)		
			Average acre yield of cane	Yield of sirup		Average acre yield of cane	Yield of sirup	
$N^{\perp}$	P_2O_5	K_2O		Per ton	Per acre		Per ton	Per acre
			Tons	Gallons	Gallons	Tons	Gallons	Gallons
20	40	20	16.68	20.2	336	13.98	20.8	290
40	40	20	18.51	19.2	355	19.33	19.1	370
60	40	20	18.83	19.5	367	20.86	20.3	395
20	80	20	13.58	19.3	263	12.43	20.1	250
40	80	20	20.36	18.1	368	19.18	20.9	401
60	80	20	17.91	18.9	338	21.14	20.1	425
0	0	0	13.14	19.5	257	11.07	19.8	219
Difference								
For P = .05			5.99	0.98	125	5.76	3.17	137
For P = .01			8.20	1.34	171	7.89	4.34	188

1. Numbers in parentheses indicate number of tests.
$^{\perp}$Nitrogen from ammonium sulphate.

3 inches from the cane on each side of the rows, the fertilizer being covered immediately to a depth of about 4 inches during the cultivation operation.

A variation from the general procedure described above for applying the fertilizer was followed at Meridian in the test summarized in table 1; prior to the planting operation phosphate (P_2O_5) was applied and mixed thoroughly with the soil at a depth of approximately 1 inch below the furrow in which the cane was planted. The method of applying nitrogen in this test was the same as the general procedure described above for other tests.

All of the tests were harvested, in accordance with usual commercial practices, during the period November 1 to 15, except in a few cases where some of the second year stubble tests were harvested during the latter part of October. Yields of cane per acre were based on plot weights of stripped cane. Border rows on each plot were eliminated from plot weights to avoid the influence of border effect from the various fertilizer treatments.

Yields of sirup per ton of cane were based on sirup tests, conducted on a laboratory scale evaporator, that involved composited samples of juice extracted from field samples of from 15 to 25 stalks selected at random from each plot of each treatment.

Discussions

The results of the fertilizer tests summarized in tables 2 to 6, inclusive, show that yields of cane and sirup per acre were improved in each case by the addition of fertilizer except in a single instance (table 6) where half of the fertilizer was applied to second year stubble in March and the remainder in June. Yields observed in all tests no doubt were influenced to some extent by seasonal conditions and by physical conditions and original fertility of the soil.

Results of tests given in table 1 vary, the observed yield of cane and sirup from approximately one-third of the total number of fertilized plots being somewhat lower than yields from the unfertilized check plots. Reason for the lower yields, as compared with increased yields from all other fertilized plots in these tests and increased yields from fertilized plots in other tests, is not apparent. However, the variations in observed yields may have resulted from obscure variations in physical conditions and fertility of the soil throughout the tract of deep

Table 3. Results of fertilizer tests on ruston atwood fine sandy loam soil; C. B. Howse's Farm, Laurel, Mississippi.[1]

Variety: Co. 290

Pounds of fertilizer per acre			Plant cane (1)			First year stubble (1)			Second year stubble (1)		
			Average acre yield	Yield of sirup		Average acre yield	Yield of sirup		Average acre yield	Yield of sirup	
N	P_2O_5	K_2O	of cane	Per ton	Per acre	of cane	Per ton	Per acre	of cane	Per ton	Per acre
			Tons	Gals.	Gals.	Tons	Gals.	Gals.	Tons	Gals.	Gals.
Nitrogen from ammonium sulphate											
32	64	32	24.09	19.1	460	24.47	17.7	433	17.54	19.2	337
64	64	32	25.91	19.0	492	28.29	19.0	538	26.23	18.8	493
96	64	32	25.32	18.6	471	28.08	18.6	522	21.28	16.6	353
Nitrogen from cottonseed meal											
32	64	32	22.93	18.5	424	18.10	17.3	313	15.76	18.9	298
64	64	32	24.57	19.9	489	25.40	20.8	528	23.68	19.0	450
96	64	32	26.52	19.1	507	25.16	18.1	455	21.43	18.5	396
32	128	32	23.46	18.5	434	21.75	16.9	368	17.65	18.3	323
64	128	32	24.00	18.8	451	23.73	18.2	432	22.68	20.0	454
96	128	32	26.68	18.2	486	28.85	16.7	482	25.29	20.2	511
0	0	0	15.21	19.1	291	11.92	20.0	238	7.73	17.2	133
Difference											
For P = .05			5.68	2.26	125	6.79	4.77	214	6.38	2.26	157
For P = .01			8.16	3.25	179	9.75	6.86	308	9.16	3.25	225

1. Numbers in parentheses indicate the number of tests. For example, plant cane tests were conducted in two different years during the six-year period 1941-1946.

Table 4. Results of fertilizer tests on ruston atwood fine sandy loam soil; C. B. Howse's Farm, Laurel, Mississippi.[1]

Variety: C. P. 29/116

Pounds of fertilizer per acre			Plant cane (1)			First year stubble (1)			Second year stubble (1)		
			Average acre yield	Yield of sirup		Average acre yield	Yield of sirup		Average acre yield	Yield of sirup	
N	P_2O_5	K_2O	of cane	Per ton	Per acre	of cane	Per ton	Per acre	of cane	Per ton	Per acre
			Tons	Gals.	Gals.	Tons	Gals.	Gals.	Tons	Gals.	Gals.
Nitrogen from ammonium sulphate											
32	64	32	25.65	17.4	446	24.56	21.9	538	19.49	19.1	372
64	64	32	24.00	17.2	413	32.75	20.8	681	23.28	18.2	424
96	64	32	28.59	15.7	449	34.40	20.1	691	28.11	18.0	506
Nitrogen from cottonseed meal											
32	64	32	21.71	18.5	402	25.84	21.5	556	16.66	19.6	427
64	64	32	21.87	16.7	365	31.23	20.4	637	22.42	19.6	439
96	64	32	29.07	17.0	494	36.29	20.8	755	26.27	19.1	502
32	128	32	21.81	17.4	379	23.15	20.9	484	18.78	18.9	355
64	128	32	27.20	17.1	465	27.50	20.8	572	21.90	18.7	410
96	128	32	28.11	15.0	422	32.96	20.5	676	24.90	18.4	458
0	0	0	16.64	18.5	308	19.23	21.2	408	12.66	19.0	241
Difference											
For P = .05			4.73	0.34	82	6.40	1.19	134	8.39	1.29	155
For P = .01			6.48	0.47	112	8.77	1.63	183	14.50	1.77	212

1. Numbers in parentheses indicate number of tests.

Table 5. Results of fertilizer tests on ruston sandy loam soil; South Mississippi Branch Station, Poplarville, Mississippi.[1]

Variety: C. P. 29/116

Pounds of fertilizer per acre			Plant cane (3)			First year stubble (3)			Second year stubble (2)		
			Average acre yield	Yield of sirup		Average acre yield	Yield of sirup		Average acre yield	Yield of sirup	
N	P_2O_5	K_2O	of cane	Per ton	Per acre	of cane	Per ton	Per acre	of cane	Per ton	Per acre
			Tons	Gals.	Gals.	Tons	Gals.	Gals.	Tons	Gals.	Gals.
Nitrogen from ammonium sulphate											
20	0	0	26.59	20.2	537	23.73	21.0	498	22.17	21.6	479
40	0	0	28.84	19.8	571	27.12	21.1	572	24.42	21.7	530
60	0	0	28.75	19.5	561	29.69	20.9	621	28.08	21.2	595
80	0	0	26.95	17.8	480	30.23	20.1	608	27.46	20.8	571
20	20	0	24.40	18.6	454	24.19	21.0	508	21.68	20.6	447
40	20	0	26.34	20.2	532	31.75	21.8	692	27.50	20.8	572
60	20	0	34.43	19.2	661	28.81	21.0	605	27.80	21.0	584
80	20	0	27.33	19.4	530	26.65	20.2	538	29.20	21.3	622
20	40	0	26.19	19.7	516	23.90	21.6	516	20.47	20.8	426
40	40	0	28.54	20.5	585	28.36	21.5	610	23.21	22.1	513
60	40	0	31.05	19.6	609	30.30	21.2	642	31.47	21.8	686
80	40	0	31.89	18.7	596	28.16	20.3	572	29.16	21.5	627
80	40	20	28.25	18.9	534	30.87	21.3	658	31.77	21.2	674
0	0	0	20.88	18.8	393	20.35	20.8	423	14.10	21.6	305
Difference											
For P = .05			5.18	1.77	106	5.20	1.86	126	13.86	1.99	300
For P = .01			7.00	2.39	144	7.03	2.51	171	19.31	2.77	418

1. Numbers in parentheses indicate number of tests. See footnote, table 3.

sandy soil in which the tests were located and in some instances by leaching of the fertilizer by rainfall.

Measurable effects of the fertilizer treatments were more pronounced in the yields of cane per acre and were in turn reflected in yields of sirup per acre. Yields of sirup per ton of cane were not influenced greatly by the fertilizer treatments except in a few cases where high applications of nitrogen resulted in immature cane at the time of harvest which lowered the yields. Yields of cane and sirup per acre improved with successive increases in fertilizer applications within certain general limitations.

The greatest response at each location was associated with the nitrogen applications. Yields of cane and sirup per acre increased with increased applications of nitrogen up to from 40 to 60 pounds per acre. In some cases the increase in yields continued with higher applications of nitrogen, though the proportionate increases were less pronounced from applications above 60 pounds per acre. The response to the nitrogen applications were influenced by seasonal conditions.

Applications of from 96 to 120 pounds of nitrogen as compared to applications of from 40 to 60 pounds of nitrogen per acre, frequently lowered the yields of sirup per ton of cane, but usually resulted in a slight increase in yield of cane and sirup per acre. In some instances applications of nitrogen supplemented by 20 to 40 pounds of P_2O_5 on Ruston sandy loam soil (table 5) resulted in better yields of cane and sirup, but in some other instances applications of nitrogen alone was as effective as when both P_2O_5 and nitrogen were used.

On a Susquehanna soil (sandy phase) near Meridian (table 1) applications of 100 pounds of P_2O_5 per acre as compared with no phosphate resulted in increased

Table 6. Results of fertilizer tests on ruston sandy loam soil; South Mississippi Branch Station. Poplarville, Mississippi.[1]

Variety: C. P. 29/116

Pounds of fertilizer per acre			Plant cane (1)			First year stubble (1)			Second year stubble (1)		
			Average acre yield	Yield of sirup		Average acre yield	Yield of sirup		Average acre yield	Yield of sirup	
N	P_2O_5	K_2O	of cane	Per ton	Per acre	of cane	Per ton	Per acre	of cane	Per ton	Per acre
			Tons	Gals.	Gals.	Tons	Gals.	Gals.	Tons	Gals.	Gals.
Nitrogen from ammonium sulphate, one application[2]											
20	40	20	19.36	21.6	418	20.68	19.4	401	21.19	19.4	411
60	40	20	24.19	22.9	554	23.41	17.9	419	24.65	17.6	434
Nitrogen from ammonium sulphate; two applications[2]											
20	40	20	19.56	23.1	452	18.55	19.0	352	15.70	17.4	273
60	40	20	22.07	21.9	483	21.67	19.1	414	20.61	16.7	344
40	80	40	23.40	22.1	517	25.11	20.0	502	27.94	17.8	497
120	80	40	26.05	23.1	602	26.70	20.4	545	25.40	19.3	490
Nitrogen from cottonseed meal; one application[1]											
20	40	20	20.57	22.8	469	20.57	21.3	438	23.83	18.7	446
60	40	20	22.31	21.9	489	23.38	21.3	498	21.77	18.0	392
Nitrogen from cottonseed meal; two applications[2]											
20	40	20	19.44	21.1	410	19.19	18.9	363	25.18	16.7	420
60	40	20	27.76	21.7	602	22.07	20.4	450	22.50	18.1	407
40	80	40	22.33	22.8	509	27.71	19.6	543	25.89	16.7	432
120	80	40	24.12	21.5	519	28.25	21.5	607	29.27	17.1	501
60	80	20	22.73	21.8	496	24.44	19.9	486	19.52	18.6	363
0	0	0	18.43	21.6	398	15.63	18.7	292	16.40	18.5	303
Difference											
For P = .05			4.32	2.59	105	5.96	3.67	136	10.04	1.22	188
For P = .01			6.02	3.61	147	8.31	5.12	191	13.44	1.63	252

1. Numbers in parentheses indicate number of tests. See footnote, table 3.

[1] Applied in March.

[2] ½ applied in March and the remainder in June.

yields of cane and sirup per acre. In other tests on that soil, and in tests on other soils, increasing the quantity of P_2O_5 from 40 to 80 pounds or from 64 to 128 pounds per acre without changing the quantities of nitrogen and potash resulted in an increase in yields of cane and sirup in some instances, while in other instances no increase in yield was obtained. The more favorable effect of applying P_2O_5 was in the case of stubble crops.

Inorganic sources of nitrogen were equally as effective as cottonseed meal as measured by the yields of cane and sirup per acre from comparable treatments. In some instances the inorganic sources of nitorgen, ammonium sulphate in particular, resulted in slightly higher yields than comparable treatments where cottonseed meal was used as a source of nitrogen, and in other instances the reverse was the case.

The results as a whole do not show appreciable differences in yields from effect of nitrogen from the inorganic sources used, cyanamid, nitrate of soda, and ammonium sulphate. Although the data (table 1) indicate slightly more favorable effect from P_2O_5 when inorganic sources of nitrogen were used than when cottonseed meal was used, the results are too limited to serve as more than an indication of possible effect.

Summary

1. Inorganic sources of nitrogen (cyanamid, nitrate of soda, and ammonium sulphate) were equally as satisfactory as

cottonseed meal in the total production of a good quality of sirup per acre.

2. Applications of nitrogen, usually from 20 to 60 pounds per acre improved the yields of cane and sirup per acre in essentially all tests; the response depending largely upon the soil type and general fertility of the land. In some of the tests, applications of nitrogen higher than the 60 pounds per acre had a detrimental effect on yield of sirup per ton of cane and on yield of sirup per acre.

Applications of 100 pounds of P_2O_5 per acre as compared to no phosphate on Susquehanna soil (sandy phase) generally improved the yield of cane and sirup per acre. In other tests on that and on the other soils, increasing the quantity of P_2O_5 from 40 to 80 or from 64 to 128 pounds per acre resulted in an increase in yields in some instances and no increase in other instances. The more favorable effect of applying P_2O_5 was in the case of stubble crops.

3. Fertilizer applied in one application in March was as effective as when the same quantity was applied in two applications, one in March and one in June, in most of the tests. Two applications gave better results in some of the second year stubble tests.

4. Because of the widely varying soil types and soil fertility throughout the sugarcane growing area of Mississippi, it is not feasible to recommend kinds and quantities of fertilizer which will prove most suitable under all conditions. In general, based on the results from tests conducted at Meridian, Laurel, and Poplarville, a mixed fertilizer high in nitrogen such as a 6-8-4 (N, P_2O_5, K_2O) should be applied at the rate of from 400 to 800 pounds per acre, depending upon the soil type and previous crop history of the land. Light sandy soils, low in fertility require, in addition to the mixed fertilizer, a supplemental application of from 20 to 30 pounds of nitrogen per acre.