Summary of Ten Years' Work with Complete Fertilizers on Sugar Cane*

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THE observations of Gouaux through many years of varietal test field work and analytical soil studies by Worsham and Sturgis (Soil Sci. Soc. Amer. Proc. 6:342-347, 1941) had by 1941 established the fact that the productive capacities and the available nutrient content of the soils in the sugar cane area were variable and in many cases low. Soil nitrogen was generally low. Forty per cent of the soils tested were so low in easily soluble phosphorus that it was apparent that sugar cane on these soils could be expected to respond to added phosphates. Over fifty per cent of the soils tested were low in exchangeable potassium, and response to potash fertilizers could be expected on the soils testing low in potassium. It was also recognized that other factors, such as high soil acidity associated with low availability of calcium and especially magnesium, the development of a plow pan in the soil, and soil acidity in relation to the choice of nitrogen fertilizers, might affect the response of sugar cane to complete fertilizers.

The results of experiments reported in the Louisiana Agricultural Experiment Station, Crops and Soils Department Annual Reports, 1948-1953, show that responses from sugar cane to dolomitic limestone or to soluble forms of magnesium have not been established.

Generally, as the depth to the plow pan or to the natural clay pan increases there is less response to added fertilizers especially with normal moisture (Soil Sci. Soc. Amer. Proc. 16:148-150, 1952). In dry years this relationship would be reversed since the deeper surface soils would furnish more available moisture which would be a more limiting factor for growth than fertilizer nutrients.

The effects of sources of nitrogen in relation to soil acidity have not been extensively studied, especially with high rates of nitrogen. The studies that have been made (Sugar Journ. 12:16-18, 1950) show that all the materials, ammonia, ammonium nitrate, urea, calcium cyanamid, and sodium nitrate, were equally effective. It might be expected, however, that after the use of high rates of the ammonium type of nitrogen carriers for many years, soil acidity could become a problem.

In beginning the experiments with complete fertilizers on sugar cane, locations were largely limited to stubble cane on the Pleistocene terrace soils. The treatments were placed in randomized blocks and replicated. The plot size chosen at each location was sufficient to yield at least a sling of cane. The fertilizers were applied in the off-bar furrow. The treatments and the average yields of cane and sugar at five locations each on Olivier silt loam, Lintonia silt loam, and Iberia silt loam during the period 1942-1944 are given in Table I. At the low level of nitrogen, 36 pounds per acre, on Olivier silt loam there was a 6.7-ton increase from the nitrogen with less than a ton response from phosphate and potash. In later

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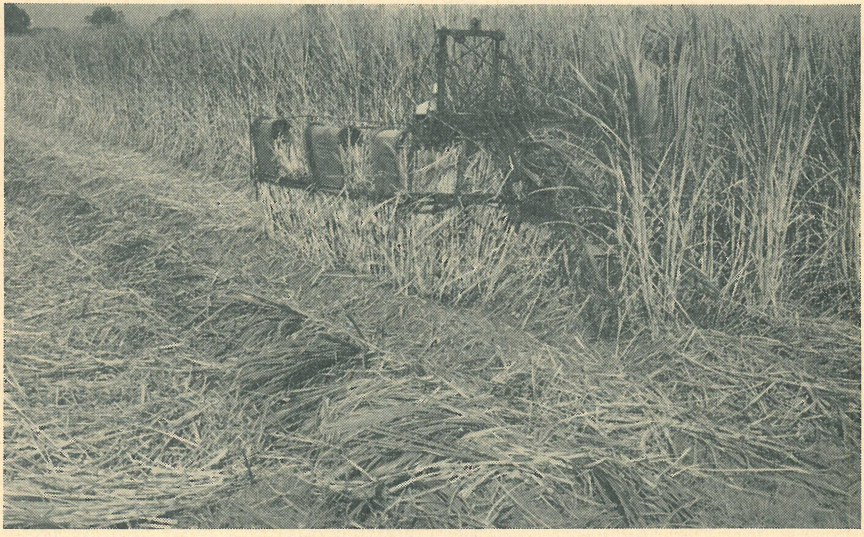

Fig. 1. Cutting sugar cane, Saint Martinville, Louisiana.

experiments, Table IV, on Olivier silt loam at the 60-pound per acre level of nitrogen, the response to phosphate and potash amounted to 4.6 tons of cane and 865 pounds of sugar per acre. At the low level of nitrogen, Lintonia silt loam reacted like the Olivier silt loam. Experiments with stubble cane on Iberia silt loam have consistently shown responses to complete fertilizers. At the 36-pound per acre level of nitrogen, Table I, there was a 3.3-ton response to nitrogen, but when phosphate and potash were added to the mixture, the response to the complete fertilizer was 6.4 tons of cane and 1,187 pounds per acre of sugar.

Experiments with plant cane at the low level of nitrogen at three locations were conducted on Olivier and Iberia soils in 1942 and 1943. The highest yields in all cases were obtained with complete fertilizers. This led to testing the responses of plant cane on the Pleistocene terrace soils at higher levels of nitrogen, phosphate, and potash. Data in Table II show that the average response of plant cane on Olivier silt loam was 5.6 tons per acre increase from 40 pounds of nitrogen. The increase from

TABLE I.—RESPONSE TO FERTILIZERS FROM STUBBLE CANE ON PLEISTOCENE TERRACE SOILS, 1942-1944

Pounds per acre plant nutrients N^1–P_2O_5–K_2O	Average of 5 locations on Olivier silt loam		Average of 5 locations on Lintonia silt loam		Average of 5 locations on Iberia silt loam	
	Tons/A cane	Lbs./A sugar	Tons/A cane	Lbs./A sugar	Tons/A cane	Lbs./A sugar
0–0–0	14.40	2,738	21.15	3,811	15.12	2,957
36–0–0	21.05	3,976	25.07	4,246	18.41	3,510
36–24–0	21.55	4,094	24.85	4,299	19.18	3,755
36–0–36	21.96	4,086	26.55	4,615	19.66	3,660
36–24–36	21.70	4,007	26.75	4,670	21.53	4,144

[1] Nitrogen from nitrate of soda; P_2O_5 from 20% superphosphate; K_2O from 50% muriate of potash.

TABLE II.—RESPONSE TO FERTILIZERS FROM PLANT CANE ON PLEISTOCENE TERRACE SOILS, 1945-1953

Pounds per acre plant nutrients N^1–P_2O_5–K_2O	Average of 3 locations on Olivier silt loam		Average of 3 locations on Iberia silt loam	
	Tons/A cane	Lbs./A sugar	Tons/A cane	Lbs./A sugar
0–0–0	21.83	3,491	21.32	3,678
40–0–0	27.46	4,126	22.15	3,916
40–0–60	28.10	4,355	25.33	4,422
40–40–60	29.68	4,760	26.98	4,746
60–0–0	27.20	4,178	23.69	4,201
60–0–60	28.26	4,522	25.31	4,281
60–40–60	30.37	4,742	25.56	4,239

[1] Nitrogen from ammonium nitrate; P_2O_5 from 20% superphosphate; K_2O from 60% muriate of potash.

40 pounds of nitrogen with 40 pounds of P_2O_5 and 60 pounds of K_2O was 1.9 tons of cane and 1,269 pounds of sugar per acre. Plant cane on Iberia silt loam, Table II, showed a more definite response to the complete fertilizer. The response to 40 pounds of nitrogen for three locations averaged less than a ton of cane per acre, while the response to 40 pounds of nitrogen with 40 pounds of P_2O_5 and 60 pounds of K_2O gave an average increase of 5.7 tons of cane and 1,068 pounds of sugar per acre.

The response of plant cane on the Recent alluvial soils to complete fertilizer is quite varied. The averages of four locations on Baldwin silt loam, Table III, show a 5.2-ton response to 60 pounds of nitrogen per acre and a 7.7-ton increase from 60 pounds of nitrogen with 40 pounds of P_2O_5 and 60 pounds of K_2O. Only one experiment was located on Commerce very fine sandy loam with plant cane. At this location there was no response to nitrogen alone, but 40 pounds of nitrogen with 40 pounds of P_2O_5 and 60 pounds of K_2O gave an increase of 14.9 tons of cane and 900 pounds of sugar. The averages from four experiments with plant cane on Mhoon silty clay loam show a response of 4.8 tons of cane to 60 pounds of nitrogen alone. The response to 60 pounds of nitrogen with 40 pounds of P_2O_5 and 60 pounds of K_2O gave an increase of 4.9 tons of cane and 900 pounds of sugar.

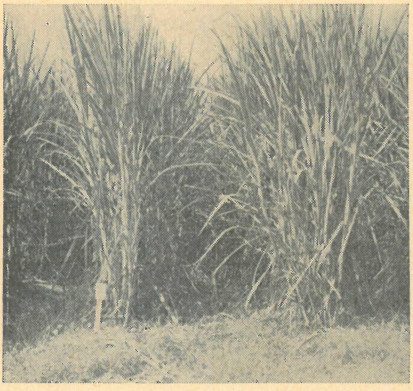

Fig. 2. No fertilizer was applied to the check plot.

Fig. 3. This plot had fertilizer at the rate of 40 lbs. N, 40 lbs. P_2O_5, and 60 lbs. K_2O per acre.

TABLE III.—RESPONSE TO FERTILIZERS FROM PLANT CANE ON ALLUVIAL SOILS, 1945-1953

Pounds per acre plant nutrients N[1]–P_2O_5–K_2O	Average of 4 locations on Baldwin silt loam		One location on Commerce very fine sandy loam		Average of 4 locations on Mhoon silty clay loam	
	Tons/A cane	Lbs./A sugar	Tons/A cane	Lbs./A sugar	Tons/A cane	Lbs./A sugar
0–0–0	25.25	4,563	31.51	5,125	23.91	4,532
40–0–0	29.41	5,258	30.16	4,870	27.72	5,255
40–0–60	29.79	5,014	32.12	5,325	27.41	5,024
40–40–60	30.93	5,587	36.40	6,025	27.27	5,140
60–0–0	30.47	5,275	31.63	5,135	28.66	5,401
60–0–60	31.82	5,523	33.58	5,495	28.06	5,317
60–40–60	32.96	5,780	33.17	5,370	30.32	5,778

[1] Nitrogen from ammonium nitrate; P_2O_5 from 20% superphosphate; K_2O from 60% muriate of potash.

The averages from four experiments with plant cane on Mhoon silty clay loam show a response of 4.8 tons of cane to 60 pounds of nitrogen alone. The response to 60 pounds of nitrogen with 40 pounds of P_2O_5 and 60 pounds of K_2O was 6.4 tons of cane and 1,246 pounds of sugar per acre.

The effects of fertilizers at the higher levels of nitrogen on the Pleistocene terrace soils with stubble cane from 1945 to 1951 indicate marked benefits from the complete fertilizers. The averages of results at three locations on Olivier silt loam, Table IV, show that 60 pounds of nitrogen alone increased the yield of cane 4.9 tons per acre. The same amount of nitrogen in combination with 40 pounds of P_2O_5 and 60 pounds of K_2O gave an increase of 9.5 tons of cane and 1,849 pounds of sugar per acre. The averages of results from five experiments with stubble cane on Richland silt loam show 4.5 tons of cane benefit from 60 pounds of nitrogen alone, while 60 pounds of nitrogen with 40 pounds of P_2O_5 and 60 pounds of K_2O gave increases of 7.5 tons of cane and 1,185 pounds of sugar per acre. Eight experiments with stubble cane on Iberia silt loam showed marked response to complete fertilizers. The average increase from 60 pounds per acre of nitrogen alone was 4.6 tons of cane. The increase from 60 pounds of nitrogen and 60 pounds of K_2O was 8.1 tons of cane, while the increase from 60 pounds of

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TABLE IV.—RESPONSE TO FERTILIZERS FROM STUBBLE CANE ON PLEISTOCENE TERRACE SOILS, 1945-1951

Pounds per acre plant nutrients N[1]–P_2O_5–K_2O	Average of 3 locations on Olivier silt loam		Average of 5 locations on Richland silt loam		Average of 8 locations on Iberia silt loam[2]	
	Tons/A cane	Lbs./A sugar	Tons/A cane	Lbs./A sugar	Tons/A cane	Lbs./A sugar
0–0–0	16.45	3,021	20.57	3,326	19.41	3,355
60–0–0	21.35	4,005	26.09	3,785	24.02	4,132
60–0–60	20.36	3,737	25.82	4,217	27.52	4,792
60–40–60	25.97	4,870	28.05	4,511	28.72	4,937

[1] Nitrogen from ammonium nitrate; P_2O_5 from 20% superphosphate; K_2O from 60% muriate of potash.
[2] At two locations 80-40-60 gave the highest yield.

calcium supply to the plant is similar to the potash supply in its location in the soil profile.

It is perfectly obvious from the profile and data that the two soils differ tremendously in practically every respect, namely, difference in depth, water absorbing and supplying capacity, acidity (pH), plant nutrients, drainage, and other characteristics. The yellowish brown sandy loam was influenced by previous soil treatment, whereas the grayish brown sandy loam had been influenced to a lesser extent.

Summary

An effort has been made to point out that each layer of soil makes a contribution to the efficient production of a crop. The plowed layer supplied predominantly the nitrogen and phosphorus, potash and water. The layer immediately below supplies potash, water, magnesium, and calcium. The depth of the soil determines the extent of this supplying capacity of the soil. A true evaluation of the soil must be based upon the whole soil and not just the surface layer.

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the fertilization and cultural practices used in conjunction with a cropping system are equally as important as the system itself in determining its effects on productivity, organic matter, tilth, and erosion control.

In summary we can say that good soil management is the key to an efficient, productive farm business. Because the soil management problems of an individual field or farm may be unique to that particular field or farm, it is essential that farmers understand their management objectives and the alternative practices that are available for meeting those objectives. The care that the farmer uses in considering the various alternatives and the skill with which he combines them into a soil management program for his particular farm will in large measure determine his production efficiency.

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nitrogen with 40 pounds of P_2O_5 and 60 pounds of K_2O was 9.3 tons of cane and 1,581 pounds of sugar. The response to potash was very marked. At two locations with stubble cane on Iberia silt loam, 80 pounds of nitrogen with 40 pounds of P_2O_5 and 60 pounds of K_2O gave the highest yields.

The response of stubble cane on Recent alluvial soils to complete fertilizers, while not so marked as to nitrogen alone, is consistent, with approximately 2 tons of increase being derived from phosphate and potash and 7 tons of increase coming from 60 pounds of nitrogen alone. Six locations on Baldwin silt loam, Table V, returned an average increase of 5.1 tons of cane from 60 pounds of nitrogen alone and an increase of 7.7 tons of cane and 1,230 pounds of sugar per acre from 60 pounds of nitrogen with 60 pounds of K_2O. The averages of five experiments with stubble cane on Commerce very fine sandy loam show 8.5 tons of benefit from 60 pounds of nitrogen alone and

increases of 10.2 tons of cane and 1,926 pounds of sugar from 60 pounds of nitrogen, 40 pounds of P_2O_5, and 60 pounds of K_2O. Five locations on Mhoon silty clay loam planted to stubble cane gave an average increase of 8.1 tons of cane for 60 pounds of nitrogen alone. The average increase from the complete application carrying 60 pounds of nitrogen, 40 pounds of P_2O_5, and 60 pounds of K_2O was 10.8 tons of cane and 2,100 pounds of sugar per acre.

TABLE V.—RESPONSE TO FERTILIZERS FROM STUBBLE CANE ON ALLUVIAL SOILS, 1945-1951

Pounds per acre plant nutrients N^1–P_2O_5–K_2O	Average of 6 locations on Baldwin silt loam[2]		Average of 5 locations on Commerce very fine sandy loam[3]		Average of 5 locations on Mhoon silty clay loam[4]	
	Tons/A cane	Lbs./A sugar	Tons/A cane	Lbs./A sugar	Tons/A cane	Lbs./A sugar
0–0–0	19.30	3,206	15.41	2,646	14.73	2,596
60–0–0	24.39	4,028	23.92	4,134	22.84	4,086
60–0–60	26.96	4,436	25.06	4,398	23.94	4,377
60–40–60	26.78	4,352	25.60	4,572	25.52	4,696

[1] Nitrogen from ammonium nitrate; P_2O_5 from 20% superphosphate; K_2O from 60% muriate of potash.
[2] At one location 80-40-60 gave the highest yield.
[3] At three locations 80-40-60 gave the highest yield.
[4] At one location 80-0-60 gave the highest yield and at another 80-40-60 gave the highest yield.

The Net Worth of Soils in the Northeast

(*From page* 10)

$32.93; for South Carolina, it was $17.96 (1950 census).

The native infertility of the soils of the Northeast, plus the intensive nature of its agriculture, is reflected in the fertilizer consumption for the area. Although only 5 per cent of the cropland and 4 per cent of the plowable pasture (Table I) in the United States are in these States, 12 per cent of the total amount of fertilizers used in this country were applied to these soils (Table II). This represented 9 per cent of the N, 12.5 per cent of the P_2O_5, and 14 per cent of the K_2O used in the United States.

TABLE II.—ESTIMATED CONSUMPTION OF N, P_2O_5, AND K_2O FOR FISCAL YEAR 1949-50 FOR SELECTED REGIONS IN THE UNITED STATES*

Region	N		P_2O_5		K_2O			
	Total tons	U.S. total	Total tons	U.S. total	Total tons	U.S. total	Grand total	U.S. total
		%		%		%		%
Northeastern	88,400	8.9	245,900	12.5	155,700	14.1	490,000	12.1
W. Northcentral	71,500	7.2	227,600	11.6	64,200	5.8	363,300	9.0
Continental U.S.	987,900	.....	1,960,900	.....	1,106,500	.....	4,055,300	.....

* Source: Production and Marketing Administration, USDA. The Fertilizer Situation for 1951-1952. Washington, D. C. 1952.