The Response of Hegari Sorghum to Lime Applications at Various Levels

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INTRODUCTION

The application of lime to acid soils brings about changes in the conditions of the soil that generally result in improving the yield of some crops. The correction of the soil reaction, as such, is one of the physiological factors involved. Other soil conditions affected include the supply of exchangeable calcium and magnesium; the availability of phosphorus; the solubility of iron, manganese, and other elements; soil structure; and the activity of the soil microorganisms.

In Puerto Rico, where more than half of the total acreage consists of acid soils, the proper use of lime is of paramount importance. May (*6*)[2] obtained response in sugarcane yields following liming of the soil. McClelland (*7*) and subsequently other investigators (*5*) failed to obtain increases in coffee yield attributable to liming. Bonnet, *et al.* (*2, 3*) measured increases in the yield of several legumes grown for green manure and of sweetpotatoes and corn. They also obtained responses to liming from various grasses when grown in association with a legume (*1*). Pennock (*8*) has reported on the influence of lime applications on pineapple growth and production.

This paper presents data obtained from a greenhouse experiment wherein the influence of various lime levels upon a crop of Hegari sorghum was measured.

EARLIER WORK

In 1937, Capó (*4*) made extensive pot tests in a detailed study of the available nutrient contents of Puerto Rican soils, using Hegari sorghum as an indicator plant. In many of the tests with very acid soils no apparent logical yield responses were obtained to increased nitrogen, phosphoric acid, and potash applications. This abnormal behavior suggested some possible physiological imbalance, the correction of which was attempted by using lime. Table 1 shows the effect of liming on sorghum dry-matter yields as measured in Capó's greenhouse experiments. Marked statistically significant beneficial effects were measured in strongly acid soil samples

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[2] Italic numbers in parentheses refer to Literature Cited, p. 238.

TABLE 1.—*Effect of liming soils on sorghum yields*[1]

Soil type	Limestone applied	Dry matter per pot
	Cwt. per A.	*Grams*
Río Piedras clay	0	6.6
	10	31.8
	20	34.8
Moca silty clay loam	0	13.2
	15	36.0
	30	58.0
Cialitos clay	0	17.4
	15	43.4
	30	41.4
Catalina clay, level phase	0	28.5
	15	45.7
	30	38.4
Vega Alta sandy loam	0	34.8
	15	46.4
	30	31.4
Los Guineos clay	0	23.5
	15	40.2
	30	46.8
Coloso clay	0	24.5
	15	41.0
	30	42.3
Coloso silt loam	0	40.9
	15	39.0
	30	44.4
Estación silt loam	0	57.2
	10	54.1
	20	53.2
Lares clay	0	55.9
	15	51.0
	30	49.0
Múcara silty clay loam	0	41.5
	15	46.4
	30	44.8
Ciales clay loam	0	39.8
	15	43.6
	30	36.6
Toa silty clay loam	0	35.1
	15	41.3
	30	36.2
Nipe clay	0	36.1
	15	24.8
	30	10.2
Cabo Rojo clay	0	25.4
	13	24.8
	26	26.6
Mabí clay	0	51.8
	13	53.2
	26	46.4

[1] Adapted from Capó, B. G. (4).

from Río Piedras clay, Moca silty clay loam, Cialitos clay, Los Guineos clay, and Coloso clay. No response was obtained in other less acid soil samples from Coloso silt loam, Estación silt loam, Lares clay, Ciales clay loam, Toa silty clay, Múcara silty clay loam, Jayuya silty clay loam, Cabo Rojo clay, and Mabí clay. In some soils like Nipe clay the use of lime even depressed sorghum yields. The results from this work led to the study herein reported where six lime levels were tested on a very acid soil from the northern area of Puerto Rico.

MATERIALS AND METHODS

A greenhouse pot experiment was conducted with Fajardo clay, an acid soil with a moderate degree of buffering. The soil was collected from the plow layer at a site that has been under clean cultivation for several years, but which had not been limed previously. Nine pounds of air-dried soil screened through a ¼-inch sieve were thoroughly mixed with 4½ pounds of very fine sand and used in filling Mitscherlich pots. The pH of the soil at the time was 4.35. Six treatments were tested by using ground limestone at the rates indicated in the following tabulation:

Treatment identification No.	*Rate of limestone applications in tons per A.*	*Expected pH*
1	0.7	4.5
2	2.2	5.0
3	4.2	5.5
4	5.8	6.0
5	7.2	6.5
6	9.2	7.0

Each treatment was replicated 12 times, including a total of 72 pots in the study. The calcium carbonate equivalent of the limestone used was 99.14 percent. The lime needed was computed on basis of the 9 pounds of soil, disregarding the sand which was used to insure adequate soil aeration and water movement. An application of the three major fertilizer elements was made to the soil in each pot. The quantities of fertilizer used were as follows: 225 pounds of nitrogen (as NH_3), 75 pounds of phosphoric acid, and 225 pounds of potash, per acre, in each case.

Thirty-seven pregerminated seeds of Hegari sorghum were planted in each pot. Water was added at frequent intervals in an attempt to maintain the soil moisture at field capacity. In order to provide as uniform an environment as possible to each of the replicates the position of the tables where the 12 pots of each replication were placed was changed every other day. A light attack of the fall armyworm (*Laphygma frugiperda*) appeared some 19 days after seeding. The insect was controlled by spraying with a 1-percent solution of DDT. Forty days after seeding, when the plants were

nearly ready for harvest, they were attacked by *Aphis maidis*, which was quickly controlled with a spray of chlordane at a 0.5-percent concentration. The sorghum plants were harvested after 49 days of growth. They were weighed and their moisture content determined. Counts were made of the number of plants in bloom in each pot.

RESULTS AND DISCUSSION

Data on the mean green- and dry-weight yields of sorghum are given in table 2. Information is also given as to the mean number of plants in bloom. Sorghum plants growing in soil receiving lime at the rate of only 0.7 ton to the acre yielded least. Throughout the course of the experiment these

TABLE 2.—*Mean yields and number of plants in bloom of Hegari sorghum grown in soil receiving different quantities of lime*

Limestone applied (t./A.)	Green matter per pot	Dry matter per pot	Plants in bloom
	Grams	*Grams*	*Number*
0.7	137	25.0	2.3
2.2	236	44.0	8.7
4.2	267	51.4	8.8
5.8	257	48.6	8.9
7.2	244	44.5	7.7
9.2	232	43.0	8.5
L.S.D. at the 5-percent level	22.8	8.9	2.2
L.S.D. at the 1-percent level	30.4	11.8	2.9

plants were always shorter and their leaves were of a light-green color with slightly yellowish tints. The mean differences in green-matter yield of sorghum in the soil receiving lime at the rate of 0.7 ton to the acre and each of the other treatments were highly significant. Furthermore, the green-matter production in the soil receiving 4.2 tons of lime to the acre was significantly higher than that from soils receiving either lesser amounts, or receiving lime at the rate of 9.2 tons to the acre.

There were highly significant differences between the dry matter produced by the sorghum grown in soil receiving lime at the rate of 0.7 ton to the acre and all other treatments. The extreme low lime treatment yielded least, but no significant differences were measured between any of the other treatments.

Table 2 further shows that liming influences significantly the blooming interval of the sorghum plant. In the extreme low lime treatment only about 2 plants on the average were able to bloom at 49 days of age while over 8

plants had bloomed in each of the other lime treatments and extremes of 10 or 11 were recorded in some cases. The results obtained from this work are in line with those obtained by Capó (*4*) in 1937, when growing Hegari sorghum on very acid soils to which no lime had been added.

In general, the production of Hegari sorghum in very acid soils can be increased by liming up to a pH of about 5.0. In soils with moderately low exchange capacity and a pH of around 4.35, these increases can be brought about by applying a little over 2 tons of limestone. For the sorghum crops further applications of lime beyond that point are of rather doubtful value since they do not influence significantly the growth and dry-matter production of sorghum.

It might be well to emphasize that both soil and crop must be considered jointly in determining lime needs. Field tests by Bonnet, *et al.* (*1*, *2*, *3*) in the same Fajardo clay used in this experiment, have shown response in several legumes, sweetpotatoes, corn, and soilage grasses, to higher lime levels than those herein reported and obtained with Hegari sorghum under greenhouse conditions. When dealing with some crops like sorghum and with soils like Fajardo clay at a pH of less than 4.5 the application of lime in excess of 2 tons or so may result in waste of money and effort.

SUMMARY

A greenhouse investigation was conducted to determine the influence of various lime levels on the growth and yields of Hegari sorghum. Green-matter yields of sorghum grown in soils receiving slightly over 4 tons of limestone to the acre were significantly higher than that from the soils receiving only 0.7 ton per acre, or receiving lime at the rate of 9.2 ton to the acre. The extreme low lime treatment, 0.7 ton to the acre, resulted in significantly lower dry-matter production, but no significant differences were measured between treatments ranging from 2.2 to 9.2 tons of lime to the acre. Liming influences significantly the blooming period of the sorghum plant.

RESUMEN

Se informan en este trabajo los resultados de una investigación hecha en el invernadero con el propósito de determinar el efecto de varios niveles de cal en el suelo sobre la producción del sorgo Hegari. Los rendimientos de materia verde en suelos que recibieron cal, a razón de poco más de 4 toneladas por acre, fueron significativamente más altos que los del suelo que recibió la cantidad menor de cal (a razón de 0.7 tonelada por acre), sin embargo, no se pudieron medir diferencias significativas entre los promedios de los demás niveles de cal que fluctuaron entre 2.2 y 9.2 toneladas por acre. El encalado afecta significativamente la época de florecida del sorgo.

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