# THE JOURNAL OF AGRICULTURE
## OF THE UNIVERSITY OF PUERTO RICO

Issued quarterly by the Agricultural Experiment Station of the University of Puerto Rico, for the publication of articles by members of its personnel, or others, dealing with any of the more technical aspects of scientific agriculture in Puerto Rico or the Caribbean Area.

Vol. LVI July 1972 No. 3


# Applicability of the Fertilizer-Yield Equation to Production of Sugar Per Acre in Puerto Rico[1]


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## INTRODUCTION

During the discussion of the paper "A new fertilizer-yield equation" by Capó (1) (presented by G. Samuels), at the meeting of the 12th Congress of the International Society of Sugarcane Technologists, the following question was raised by A. J. Vlitos: "If Dr. Capó had expressed $Y$ as tons of sugar per acre rather than tons of cane would he have obtained a similar curve?" (1, p. 389). In the present paper data are presented in which the fertilizer-yield equation was used to explain data of tons of sugar per acre in sugarcane experiments in Puerto Rico.

The equation suggested by Capó (1) to represent the fertilizer yield relation is

$$Y = \frac{A}{1 + B(X - C)^2}$$

where $X$ is the quantity of fertilizer applied to the soil and $Y$ is the yield of the crop grown thereon. In the equation, $A$, $B$, and $C$ are parameters: $A$ represents the maximum yield obtainable in the given field with the optimum fertilizer application, $C$, under the prevalent climatic and other environmental conditions. $B$ may be assumed to be an index of the variability of the crop yield as the quantity of the respective fertilizer material applied differs from the optimum application, $C$. The equation is symmetrical, being concave upwards for low or high values of $X$, and concave downwards for values of $X$ near $C$.

## EXPERIMENTAL DATA

A number of experiments were planned at the Agricultural Experiment Station of the University of Puerto Rico for the purpose of developing data


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for use in evaluating more closely the nature of the fertilizer-yield relationship. These experiments were intended to be carried out with many crops and fertilizer materials in different soils representative of the various crop-producing areas of Puerto Rico.

A series of experiments were performed at several locations on the Island. In each of these, nine levels of application of the corresponding nitrogen-, phosphorus-, potassium-, calcium- or magnesium-bearing fertilizer material

TABLE 1.—*Results obtained on fitting fertilizer-yield equation to data of nitrogen experiment with sugarcane variety P.R. 980*

| Location | Corozal | Guayama | Gurabo | Isabela | Lajas | Río Piedras | Río Piedras |
|---|---|---|---|---|---|---|---|
| Soil type | Cialitos clay | Machete clay | Mabi clay | Coto clay | Fraternidad clay Saline phase | Toa sandy loam (T) | Vega Alta clay loam (VA) |
| Planting date | 5/9/63 | 11/7/62 | 12/19/62 | 11/28/62 | 2/14/63 | 7/10/63 | 3/24/63 |
| Harvesting date | 6/8–10/64 | 3/16–17/64 | 2/25–27/62 | 2/3–4/64 | 4/27–29/64 | 6/11–12/64 | 5/4–6/64 |
| Age at harvest | 55.4 weeks | 70.3 weeks | 62 weeks | 57.4 weeks | 62.4 weeks | 48 weeks | 53.7 weeks |

*Fertilizer treatments and mean yields*

| Treatment Number | Units N[1] | Y[2] | Y'[3] | Y | Y' | Y | Y' | Y | Y' | Y | Y' | Y | Y' | Y | Y' |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.00 | 4.7 | 5.22 | 6.0 | 7.77 | 6.7 | 8.83 | 10.4 | 9.58 | 8.6 | 8.59 | 6.5 | 6.14 | 5.7 | 5.36 |
| 2 | .05 | 5.0 | 5.30 | 8.7 | 8.04 | 9.1 | 9.12 | 9.0 | 9.70 | 7.8 | 8.62 | 6.3 | 6.12 | 5.2 | 5.27 |
| 3 | .10 | 5.9 | 5.37 | 7.4 | 8.31 | 9.4 | 9.41 | 9.3 | 9.81 | 9.3 | 8.66 | 6.7 | 6.10 | 4.8 | 5.18 |
| 4 | .15 | 5.8 | 5.45 | 7.9 | 8.59 | 9.3 | 9.70 | 9.8 | 9.92 | 7.9 | 8.69 | 3.8 | 6.08 | 5.2 | 5.10 |
| 5 | .20 | 5.6 | 5.52 | 11.0 | 8.87 | 10.6 | 9.99 | 10.8 | 10.03 | 9.5 | 8.73 | 8.7 | 6.06 | 5.2 | 5.03 |
| 6 | .30 | 5.7 | 5.66 | 11.2 | 9.45 | 12.7 | 10.56 | 9.6 | 10.22 | 9.5 | 8.79 | 5.3 | 6.01 | 5.0 | 4.89 |
| 7 | .60 | 5.9 | 6.04 | 9.7 | 11.11 | 12.1 | 12.03 | 11.3 | 10.69 | 8.4 | 8.92 | 4.3 | 5.87 | 3.9 | 4.60 |
| 8 | 1.20 | 6.4 | 6.45 | 12.8 | 12.60 | 11.4 | 12.35 | 10.6 | 10.88 | 9.0 | 9.00 | 6.5 | 5.58 | 5.0 | 4.38 |
| 9 | 2.00 | 6.1 | 6.07 | 9.2 | 9.19 | 8.9 | 8.22 | 9.7 | 9.62 | 8.7 | 8.67 | 5.1 | 5.18 | 4.6 | 4.73 |

*Statistics of fitted equations*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | 6.462 | 12.641 | 12.750 | 10.945 | 9.009 | 6.828 | 4.387 |
| B | .137 | .492 | .496 | .140 | .044 | .013 | −.122 |
| C | 1.313 | 1.128 | .946 | 1.008 | 1.055 | −2.879 | 1.225 |
| C.D.[4] | .645 | .594 | .604 | .374 | .049 | .046 | .398 |

[1] 1 unit of N = 1,000 lb. N per acre.
[2] Y = Observed mean yield in tons of sugar per acre.
[3] Y' = Mean yield in tons of sugar per acre estimated with the fitted equation.
[4] C.D. = Coefficient of determination.

were tested while all other nutrients were applied uniformly in quantities considered adequate for satisfactory crop yields. The levels tested varied from zero to amounts considered, a priori, excessive and probably harmful to the yield of the crop. Thirty-three experiments, at seven locations, are reported and discussed in this paper. These experiments were designed as simple lattices with nine treatments.

The following data is provided in tables 1 to 5 with regard to each experi-

TABLE 2.—*Results obtained on fitting fertilizer-yield equation to data of phosphorus experiments with sugarcane variety P.R. 980*

| Location | | Corozal | | Guayama | | Gurabo | | Isabela | | Lajas | | (T) Río Piedras | | (VA) Río Piedras | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatment Number | Units P[1] | Y[2] | Y'[3] | Y | Y' | Y | Y' | Y | Y' | Y | Y' | Y | Y' | Y | Y' |
| 1 | 0.00 | 5.5 | 5.72 | 10.2 | 11.27 | 9.6 | 9.95 | 11.5 | 10.95 | 9.7 | 10.68 | 5.2 | 4.98 | 5.7 | 4.77 |
| 2 | .05 | 5.5 | 5.78 | 10.1 | 11.30 | 11.4 | 10.03 | 9.9 | 11.00 | 10.6 | 10.84 | 5.3 | 4.99 | 4.1 | 4.79 |
| 3 | .10 | 5.3 | 5.84 | 12.1 | 11.33 | 10.8 | 10.10 | 12.1 | 11.05 | 11.4 | 11.00 | 4.8 | 4.99 | 3.7 | 4.81 |
| 4 | .15 | 7.2 | 5.90 | 12.8 | 11.36 | 9.4 | 10.18 | 11.3 | 11.11 | 11.8 | 11.14 | 4.5 | 5.00 | 4.2 | 4.83 |
| 5 | .20 | 6.1 | 5.95 | 11.2 | 11.38 | 9.8 | 10.26 | 11.1 | 11.16 | 11.4 | 11.28 | 4.7 | 5.00 | 6.3 | 4.83 |
| 6 | .50 | 5.7 | 6.18 | 13.4 | 11.42 | 9.8 | 10.71 | 10.5 | 11.44 | 12.3 | 11.94 | 6.1 | 5.03 | 4.9 | 4.79 |
| 7 | .75 | 6.5 | 6.14 | 10.3 | 11.35 | 11.1 | 11.06 | 11.4 | 11.66 | 12.7 | 12.17 | 4.4 | 5.04 | 5.5 | 4.64 |
| 8 | 1.00 | 5.9 | 6.14 | 9.8 | 11.18 | 11.8 | 11.39 | 12.5 | 11.84 | 10.8 | 12.08 | 5.1 | 5.05 | 3.1 | 4.40 |
| 9 | 1.50 | 5.6 | 5.61 | 11.3 | 10.58 | 12.0 | 11.95 | 12.1 | 12.12 | 11.5 | 11.03 | 5.1 | 5.06 | 4.2 | 3.77 |
| *Statistics of fitted equations* | | | | | | | | | | | | | | | |
| A | | 6.234 | | 11.430 | | 12.507 | | 12.280 | | 12.184 | | 5.064 | | 4.844 | |
| B | | .178 | | .072 | | .038 | | .025 | | .217 | | .009 | | .188 | |
| C | | .709 | | .444 | | 2.610 | | 2.219 | | .805 | | 1.321 | | .272 | |
| C.D.[4] | | .119 | | .035 | | .465 | | .245 | | .404 | | .003 | | .101 | |

[1] 1 unit of P = 1,000 lb. P per acre.
[2] Y = Observed mean yield of tons of sugar per acre.
[3] Y' = Mean yield in tons of sugar per acre estimated with the fitted equation.
[4] C.D. = Coefficient of determination.

ment: crop and variety, geographical location, soil type of the experimental field, planting and havesting dates, age at harvest, fertilizer treatments and crop yields.

## STATISTICAL CALCULATIONS

In a previous article by Capó (2) the treatment mean yields of some of these experiments were estimated as if the experiments had been set up as fully randomized blocks and the fertilizer-yield equation was then fitted to

the estimated treatment yields as indicated. In this paper the treatment yields were estimated in accordance with the corresponding experimental design, that is, a simple lattice.

The fertilizer yield equation was fitted to the treatment means by expanding the fertilizer yield equation by Taylor's Theorem, assuming tentative values for parameters $A$, $B$ and $C$ and calculating corrections to these values by the method of least squares. The corrections to the values of the parameters were estimated by iteration, starting with assumed tentative values for $C$, $B$ and $A$, and estimating corrections for them one at a time until the sum of squares of the differences between estimated and observed mean yields was reduced to a minimum. The calculations were performed with the IBM 1130 computer.

The corresponding treatment mean yields, values of parameters $A$, $B$, and $C$, and coefficients of determination are presented in the following tables.

## RESULTS OF THE STATISTICAL CALCULATIONS

### NITROGEN EXPERIMENTS

Table 1 presents the data from seven experiments with ammonium sulfate, in which the nitrogen applications were varied from zero to 2,000 pounds of nitrogen per acre.

The values of $B$ in the respective experiment are: 0.137, 0.492, 0.496, 0.140, 0.044, 0.013, and $-0.122$.

The coefficients of determination were good in Corozal (0.645), fair at Guayama (0.594) and Gurabo (0.604), and poor in Isabela (0.374) and Río Piedras (VA) (0.398). In Lajas (0.049) and Río Piedras (T) (0.046) the fit of the curve was not satisfactory, due possibly to the lack of definite trends in the observations.

### PHOSPHORUS EXPERIMENTS

Table 2 presents the data from the seven experiments with calcium superphosphate, in which the phosphorus applications varied from zero to 1,500 pounds per acre.

The estimated $B$ values are 0.178, 0.072, 0.038, 0.025, 0.217, 0.009, and 0.188.

The coefficients of determination are fair in Gurabo (0.465) and poor at Lajar (0.404), Corozal (0.119), Isabela (0.245) and Río Piedras (VA) (0.101). In Guayama (0.035) and Río Piedras (T) (0.003) the fit of the curve was very poor.

### POTASSIUM EXPERIMENTS

Table 3 provides the data from seven experiments with muriate of potash in which the potassium applications varied from zero to 10,000 pounds per acre.

The estimated B values are: −0.00003, 0.002, 0.113, 0.002, 0.003, 0.007 and 0.005. The coefficient of determination was very good at Gurabo (0.834),** fair at Guayama (0.549) and Río Piedras (VA) (0.560), and poor at Río Piedras (T) (0.372) and Lajas (0.130). At Corozal (0.019) and Isabela (0.010) the fit of the curve was very poor.

### CALCIUM EXPERIMENTS

Table 4 presents the data from five experiments with calcium carbonate in which the calcium applications varied from zero to 4,000 pounds per acre.

TABLE 3.—*Results obtained on fitting fertilizer-yield equation to data of potassium experiments with sugarcane variety P.R. 980*

| Location | | Corozal | | Guayama | | Gurabo | | Isabela | | Lajas | | (T) Río Piedras | | (VA) Río Piedras | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatment Number | Units K[1] | Y[2] | Y'[3] | Y | Y' | Y | Y' | Y | Y' | Y | Y' | Y | Y' | Y | Y' |
| 1 | 0.00 | 5.8 | 6.33 | 12.2 | 10.66 | 10.7 | 10.42 | 11.1 | 11.24 | 9.5 | 10.62 | 4.9 | 5.68 | 3.6 | 4.66 |
| 2 | .05 | 6.3 | 6.33 | 11.8 | 10.65 | 8.4 | 10.55 | 11.1 | 11.25 | 9.9 | 10.63 | 5.5 | 5.70 | 5.4 | 4.65 |
| 3 | .10 | 6.2 | 6.33 | 9.8 | 10.63 | 13.0 | 10.68 | 9.5 | 11.27 | 10.2 | 10.64 | 5.8 | 5.71 | 4.8 | 4.65 |
| 4 | .15 | 6.0 | 6.33 | 10.9 | 10.61 | 11.6 | 10.80 | 12.1 | 11.28 | 10.4 | 10.65 | 6.4 | 5.73 | 4.6 | 4.65 |
| 5 | .20 | 6.7 | 6.32 | 11.0 | 10.59 | 9.5 | 10.93 | 12.1 | 11.30 | 11.1 | 10.66 | 5.8 | 5.75 | 5.1 | 4.65 |
| 6 | .50 | 6.7 | 6.32 | 8.5 | 10.48 | 11.7 | 11.60 | 10.9 | 11.38 | 12.5 | 10.71 | 6.4 | 5.85 | 4.5 | 4.64 |
| 7 | 2.00 | 6.5 | 6.30 | 8.7 | 9.91 | 12.1 | 11.91 | 13.5 | 11.75 | 12.0 | 10.86 | 5.8 | 6.28 | 4.4 | 4.51 |
| 8 | 5.00 | 6.5 | 6.26 | 9.4 | 8.73 | 4.3 | 4.96 | 11.2 | 12.18 | 9.7 | 10.76 | 6.8 | 6.63 | 4.1 | 4.04 |
| 9 | 10.00 | 6.0 | 6.20 | 7.0 | 6.91 | 3.1 | 1.31 | 12.0 | 11.80 | 9.8 | 9.52 | 5.5 | 5.53 | 3.0 | 3.01 |
| *Statistics of fitted equations* | | | | | | | | | | | | | | | |
| A | | 6.008 | | 12.495 | | 12.518 | | 12.224 | | 10.895 | | 6.639 | | 4.672 | |
| B | | −.00003 | | .002 | | .113 | | .002 | | .003 | | .007 | | .005 | |
| C | | 44.564 | | −8.542 | | 1.333 | | 6.106 | | 2.942 | | 4.785 | | −.694 | |
| C.D.[4] | | .019 | | .549 | | .834** | | .010 | | .130 | | .372 | | .560 | |

[1] 1 unit of K = 1,000 lb. K per acre.
[2] Y = Observed mean yield in tons of sugar per acre.
[3] Y' = Mean yield in tons of sugar per acre estimated with the fitted equation.
[4] C.D. = Coefficient of determination.
** Significant at 1-percent level.

The estimated B values are: 0.022, 0.0007, 0.00002, 0.005, and 0.006. The coefficient of determination was good at Corozal (0.702)*, and poor at Isabela (0.365) and Río Piedras (VA) (0.439). At Lajas (0.0002) and Río Piedras (T) (0.037) the fit of the curve was very poor.

### MAGNESIUM EXPERIMENTS

Table 5 presents the data from seven experiments with magnesium sulfate in which the magnesium application varied from zero to 1,200 pounds per acre.

The estimated B values are 0.0001, 1.119, 0.00000004, 0.171, 0.162, 0.432 and −0.179.

The coefficient of determination was good at Guayama (0.741)*, and poor at Río Piedras (VA) (0.431) Isabela (0.170), Lajas (0.146) and Río Piedras (T) (0.194). At Corozal (0.0006) and Gurabo (0.00000007) the fit of the curve was very poor.

TABLE 4.—*Results obtained on fitting fertilizer-yield equation to data of calcium experiments with sugarcane variety P.R. 980*

| Location | | Corozal | | Isabela | | Lajas | | (T) Río Piedras | | (VA) Río Piedras | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatment Number | Units Ca[1] | Y[2] | Y'[3] | Y | Y' | Y | Y' | Y | Y' | Y | Y' |
| 1 | 0.00 | 5.7 | 5.60 | 11.9 | 11.72 | 9.6 | 9.02 | 5.9 | 6.03 | 5.7 | 5.62 |
| 2 | .40 | 6.1 | 5.84 | 11.8 | 11.63 | 7.6 | 9.03 | 6.7 | 6.05 | 5.0 | 5.51 |
| 3 | .80 | 5.8 | 6.07 | 11.7 | 11.55 | 9.8 | 9.03 | 5.7 | 6.07 | 5.7 | 5.39 |
| 4 | 1.20 | 6.1 | 6.27 | 11.6 | 11.46 | 9.6 | 9.03 | 5.8 | 6.08 | 6.1 | 5.28 |
| 5 | 1.60 | 6.4 | 6.43 | 10.4 | 11.37 | 9.5 | 9.04 | 6.0 | 6.08 | 4.7 | 5.15 |
| 6 | 2.00 | 6.3 | 6.56 | 11.3 | 11.28 | 8.7 | 9.04 | 5.8 | 6.07 | 4.6 | 5.03 |
| 7 | 2.40 | 7.1 | 6.65 | 11.3 | 11.19 | 7.9 | 9.05 | 6.6 | 6.04 | 5.2 | 4.91 |
| 8 | 3.20 | 6.8 | 6.69 | 11.0 | 11.01 | 9.4 | 9.05 | 6.1 | 5.97 | 4.4 | 4.66 |
| 9 | 4.00 | 6.4 | 6.54 | 11.1 | 10.83 | 9.3 | 9.06 | 5.7 | 5.86 | 4.6 | 4.41 |
| *Statistics of fitted equations* | | | | | | | | | | | |
| A | | 6.701 | | 13.639 | | 9.232 | | 6.0085 | | 6.356 | |
| B | | .022 | | .0007 | | .00002 | | .005 | | .006 | |
| C | | 2.957 | | −15.465 | | 38.810 | | 1.314 | | −4.740 | |
| C.D.[4] | | .702* | | .365 | | .0002 | | .037 | | .439 | |

[1] 1 unit of Ca = 1,000 lb. Ca per acre.
[2] Y = Observed mean yield in tons of sugar per acre.
[3] Y' = Mean yield in tons of sugar per acre estimated with the fitted equation.
[4] C.D. = Coefficient of determination.
* Significant at 5-percent level.

## DISCUSSION OF RESULTS

On reviewing the data presented herein the *B* values estimated tend to be low for potassium and calcium while generally high for nitrogen, phosphorus and magnesium. This suggests that it is more important to keep the levels of nitrogen, phosphorus and magnesium near their optimum levels than it is for potassium and calcium. *C* values fluctuated from high to low values. *C* may be assumed to be an indication of how much the fertilizer status of the soil differs from the optimum in regard to content of the corresponding fertilizer material. Low values of *C* show that the soil required

TABLE 5.—*Results obtained on fitting fertilizer yield equation to data of magnesium experiments with sugarcane variety P.R. 980*

| Location | | Corozal | | Guayama | | Gurabo | | Isabela | | Lajas | | (T) Río Piedras | | (VA) Río Piedras | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatment Number | Units Mg[1] | Y[2] | Y'[3] | Y | Y' | Y | Y' | Y | Y' | Y | Y' | Y | Y' | Y | Y' |
| 1 | 0.00 | 6.6 | 6.35 | 8.7 | 8.72 | 13.7 | 11.46 | 10.4 | 9.45 | 8.6 | 8.27 | 5.2 | 5.64 | 5.7 | 5.85 |
| 2 | .12 | 5.8 | 6.35 | 10.4 | 9.79 | 7.8 | 11.46 | 9.1 | 9.70 | 7.8 | 8.47 | 5.4 | 5.87 | 5.2 | 5.32 |
| 3 | .24 | 6.7 | 6.36 | 9.2 | 10.87 | 12.4 | 11.46 | 9.3 | 9.93 | 9.3 | 8.65 | 7.1 | 6.05 | 4.8 | 5.12 |
| 4 | .36 | 6.5 | 6.36 | 13.0 | 11.86 | 12.4 | 11.46 | 9.8 | 10.11 | 7.9 | 8.79 | 7.3 | 6.16 | 5.2 | 4.96 |
| 5 | .48 | 6.4 | 6.36 | 12.6 | 12.64 | 10.5 | 11.46 | 10.8 | 10.25 | 9.5 | 8.90 | 5.2 | 6.19 | 5.2 | 4.84 |
| 6 | .60 | 6.4 | 6.36 | 14.0 | 13.09 | 11.5 | 11.46 | 9.6 | 10.34 | 9.5 | 8.97 | 6.1 | 6.15 | 5.0 | 4.75 |
| 7 | .72 | 6.1 | 6.37 | 11.9 | 13.14 | 12.5 | 11.46 | 11.3 | 10.39 | 8.4 | 8.99 | 5.3 | 6.03 | 3.9 | 4.68 |
| 8 | .96 | 6.2 | 6.37 | 12.4 | 12.07 | 10.4 | 11.46 | 10.6 | 10.32 | 9.0 | 8.92 | 6.1 | 5.62 | 5.0 | 4.63 |
| 9 | 1.20 | 6.6 | 6.38 | 10.1 | 10.07 | 12.0 | 11.46 | 9.7 | 10.06 | 8.7 | 8.69 | 5.1 | 5.04 | 4.6 | 4.67 |

*Statistics of fitted equations*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | 6.478 | 13.178 | 11.467 | 10.396 | 9.000 | 6.196 | 4.633 |
| B | .0001 | 1.119 | .00000004 | .171 | .162 | .432 | −.179 |
| C | 12.517 | .675 | −102.704 | .763 | .736 | .473 | .973 |
| C.D.[4] | .0006 | .741* | .00000007 | .170 | .146 | .194 | .431 |

[1] 1 unit of Mg = 1,000 lb. Mg. per acre.
[2] Y = Observed mean yield in tons of cane per acre.
[3] Y' = Mean yield in tons of cane per acre estimated with the fitted equation.
[4] C.D. = Coefficient of determination.
* Significant at 5-percent level.

only a small addition of the fertilizer material to yield maximally. In relation to the coefficients of determination obtained by fitting the equation, some fits were good, some very poor. Also, the data from some of the experiments could not be fitted by the equation.

When comparing the 33 coefficients of determination of the data in tons of sugarcane against tons of sugar per acre, it was found that the coefficients of determination were higher in the proportion 19 to 14 in favor of tons of sugarcane per acre.

Although similar curves are obtained using either sugarcane or sugar per acre, from the practical standpoint, the sugarcane per acre data may be more convenient to use because the estimation of the optimum economic fertilizer application would be less difficult (3,4).

## SUMMARY

The fertilizer-yield equation was used to describe the relationship between the applications of nitrogen, phosphorus, potassium, calcium and

magnesium-bearing materials and the yield in tons of sugar per acre in 33 sugarcane experiments carried out in various regions of Puerto Rico. Similar curves were obtained when the equation was fitted using data in tons of sugarcane per acre (1,2).

The *B* values estimated tend to be low for potassium and calcium and generally high for nitrogen, phosphorus and magnesium. *C* fluctuated from high to low values. This suggests it is more important to keep the levels of nitrogen, phosphorus and magnesium near their optimum levels than potassium and calcium. The coefficients of determination ranged from very good to very poor fit.

From the practical standpoint, sugarcane per acre data may be more convenient for use in estimating optimum fertilizer applications than sugar per acre data.


## RESUMEN

Se utilizó la ecuación abono-rendimiento para describir la relación entre las aplicaciones de materiales fertilizantes conteniendo nitrógeno, fósforo, potasio, calcio y magnesio y el rendimiento expresado en toneladas de azúcar por acre en 33 experimentos de caña de azúcar realizados en varias regiones de Puerto Rico. Las curvas ajustadas fueron similares a las obtenidas cuando la ecuación se ajustó a los rendimientos en toneladas de caña por acre.

Los valores estimados de *B* tendieron a ser bajos para el potasio y calcio mientras que para el nitrógeno, fósforo y magnesio dichos valores fueron generalmente altos. El valor de *C* fluctuó de valores bajos a altos. Esto sugiere que es más importante mantener los niveles de nitrógeno, fósforo y magnesio cerca de sus niveles óptimos que en los casos del potasio y calcio. Los coeficientes de determinación fluctuaron de muy buenos a muy malos.

Desde un punto de vista práctico los datos de producción de caña por acre pueden ser más utiles para estimar las cantidades óptimas de abono que deban aplicarse que los de producción de azúcar.


## LITERATURE CITED


1. Capó, B. G., A new fertilizer-yield equation, Proc. 12th Cong. Int. Soc. Sugarcane Tech., pp. 380–9, 1965.
2. ——, Additional evidence on the applicability of the new fertilizer-yield relation, J. Agr. Univ. P. R. 51 (2): 97–120, 1967.
3. ——, Optimum economic use of fertilizers for sugarcane based on leaf analysis, Communication to the XIV Cong. of the Int. Soc. Sugarcane Tech. held in Louisiana, 1971.
4. Spillman, W. J., The Law of Diminishing Increment, The Law of Diminishing Returns, Part 1, World Book Co. Chicago, Ill., 1924.