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Influence of Fertility Levels on the Varietal Response of Sugarcane

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INTRODUCTION

There are many as yet unanswered questions concerning the relationships existing between sugarcane varieties and fertilizer applications or soil fertility. These questions are propounded by geneticists, agronomists, and soil technologists. Important among them are the following:

1. *Are the results of sugarcane-variety field trials valid for different fertility levels when they are performed at but one fertility level?*

The performance of field trials in sugarcane-variety research is normally carried out by planting the varieties to be tested in a given pattern to insure randomization, fertilizing all varieties at the same level, and then comparing yields of cane tonnage, sugar tonnage, and sucrose content. This procedure has been open to criticism in that, since all varieties are tested at a given fertility level, differences in cane-variety performance caused by fertility-level differences do not become evident. In other words, a high-yielding cane variety may not hold the same rank at high- or low-nitrogen levels as in a variety trial under a medium-nitrogen level. The same might hold for phosphorus or potassium differences in fertility.

2. *Is it necessary to run fertilizer field trials on new varieties?*

The agronomist is concerned as to whether all sugarcane varieties exhibit a similar response to fertilizer applications. If so, then it is not necessary to perform new fertilizer trials every time a new variety appears for commercial use. If not, then it is incorrect to make a fertilizer recommendation for a cane variety on the basis of data from field tests with another variety.

3. *Should certain sugarcane varieties be recommended for soils of low fertility and different varieties for soils of medium or higher fertility?*

Very often different cane varieties have been recommended for soils of low and of high fertility. These recommendations have usually been based

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TABLE 1.—*General field data of the variety-fertilizer experiments with sugarcane evaluated herein, which were carried on in different areas of Puerto Rico*

Areas and experiment No.	Location	Soil type	Varieties	Fertilizer levels	Replications	Plot size	Crops
				Number	*Number*	*Acre*	*Number*
Humid							
1	Colonia San Francisco, Central Cambalache, Arecibo	Coloso silty clay	P.O.J. 2878, P.R. 903, M. 275, M. 317	7	9	1/72	5
2	Central Coloso, Aguadilla	Coloso clay	M. 28, M. 275, P.R. 902 P.R. 905	7	9	1/60	4
3	Field 7, Colonia Constancia, Toa Baja	Coloso silt loam	B.H. 10(12), P.O.J. 2878, M. 28, M. 275	7	6	1/30	2
Semihumid							
4	Isabela Substation, Isabela	Coto clay	M. 28, P.O.J. 2878, P.R. 902, P.R. 905	7	9	1/68	4
Arid-nonirrigated							
5	Lajas Substation, Lajas	Fraternidad clay	P.O.J. 2878, P.R. 905, P.R. 902, B. 34104	10	6	1/100	1
Arid-irrigated							
6	Sta. Ana Field, Colonia Josefa, Aguirre	Machete clay loam	P.O.J. 2961, B.H. 10(12) P.O.J. 2878, M. 341	10	6	1/60	1
7	Field 31, Central Aguirre, Aguirre	Aguirre clay	B.H. 10(12), P.O.J. 2878	12	8	1/75	1
8	Central Mercedita, Ponce	Mercedita clay	B.H. 10(12), P.O.J. 2878	12	8	1/75	1

on empirical characteristics and observations but rarely have data been available concerning the yield response of different varieties to different fertilizers applied at different levels.

OBJECTIVES

Accordingly, to determine whether differences in variety response can be expected when fertilizers or fertility levels are varied, data were analyzed from a series of variety-fertilizer sugarcane experiments conducted by the Agronomy and Horticulture Department of the Agricultural Experiment Station of the University of Puerto Rico. The purpose of this paper is to evaluate the interactions between cane varieties and fertility levels as used in these field experiments in order to determine whether significant and measurable differences exist, and whether valid answers can be found to the three basic questions mentioned above.

PROCEDURE

The experiments were conducted with 11 sugarcane varieties on 6 soil series. The complete list of varieties, soils, and locations is given in table 1. The fertility levels were controlled by differential fertilization as indicated in the fertilizer-treatment columns of tables 2 to 4, inclusive (see pp., 132, 135–7). The treatment where none of a particular fertilizer element was applied was considered the low instead of the no-fertility level for that element, as there was always some natural supply of the particular element already in the soil.

All experiments were harvested according to standard procedures of the Station, and yields were calculated and analyzed statistically according to the layout of the individual experiment.

RESULTS

The yields of the cane varieties at the different fertilizer levels are given in tables 2 to 4 (pp. 132, 135–7). The experiments chosen represent the humid, semihumid, arid-irrigated, and arid-nonirrigated areas. For the sake of brevity, it was assumed that the fertility status of a particular soil in those experiments was high in regard to the element concerned when additional application produced no significant yield increase. In these cases, the varying treatments were omitted from the tables except for the high-fertility level.

THE HUMID AREA

Results of the Colonia San Francisco, the Central Coloso, and the Colonia Constancia, experiments are shown in table 2.

Colonia San Francisco Experiment

NITROGEN.—At the low-nitrogen level, P.O.J. 2878 was significantly

TABLE 2.—*Comparison of the yield of sugarcane varieties at different fertilizer levels in the humid area*

Treatment No.	Fertility level	Fertilizer treatment per acre of— N	P₂O₅	K₂O	Yield of available 96° sugar per acre for— P.O.J. 2878	P.R. 903	M. 275	M. 317

Colonia San Francisco experiment

Treatment No.	Fertility level	N	P_2O_5	K_2O	P.O.J. 2878	P.R. 903	M. 275	M. 317
		Lb.	*Lb.*	*Lb.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*
1	Low N	0	300	300	101	98	91	92
2	Medium N	125	300	300	134	146	128	136
3	Low K	250	300	0	126	143	127	135
4	Medium K	250	300	150	139	158	126	137
5	High N, P, K	250	300	300	141	160	138	145

Least significant difference needed between fertilizer treatments for any one variety at:

5-percent level	7	7	7	7
1-percent level	10	10	10	10

Least significant difference needed between varieties for any one fertilizer treatment:

5-percent level	9	9	9	9
1-percent level	12	12	12	12

Central Coloso experiment

Treatment No.	Fertility level	N	P_2O_5	K_2O	M. 28	M. 275	P.R. 902	P.R. 905
					Cwt.	*Cwt.*	*Cwt.*	*Cwt.*
1	Low N	0	300	300	79	86	97	87
2	Medium N	125	300	300	107	116	126	120
3	Low K	250	300	0	108	104	114	111
4	Medium K	250	300	150	115	121	122	125
5	High N, P, K	250	300	300	111	130	132	128

Least significant difference needed between fertilizer treatments for any one variety at:

5-percent level	8	8	8	8
1-percent level	10	10	10	10

Least significant difference needed between varieties for any one fertilizer treatment:

5-percent level	9	9	9	9
1-percent level	11	11	11	11

Colonia Constancia experiment

Treatment No.	Fertility level	N	P_2O_5	K_2O	B.H. 10(12)	P.O.J. 2878	M. 28	M. 275
					Cwt.	*Cwt.*	*Cwt.*	*Cwt.*
1	Low N	0	200	200	47	45	36	42
2	Medium N	83	200	200	55	58	50	50
3	Low K	165	200	0	54	56	53	55
4	Medium K	165	200	100	57	60	55	60
5	High N, P, K	165	200	200	59	63	54	65

TABLE 2.—*Continued*

Least significant difference needed between fertilizer treatments for any one variety at:				
5-percent level	5	5	5	5
1-percent level	7	7	7	7
Least significant difference needed between varieties for any one fertilizer treatment at:				
5-percent level	6	6	6	6

better than M. 275 and M. 317. For the medium- and high-nitrogen levels P.R. 903 yielded best, followed by M. 317, P.O.J. 2878, and M. 275, in order. In this experiment P.O.J. 2878 had good yielding power as compared with the other varieties at the low-nitrogen level, but at higher levels it was inferior to P.R. 903. All four varieties displayed a significant response to all nitrogen applications.

PHOSPHORUS.—No significant response was obtained to phosphate fertilizer, so this soil may be considered as having a high phosphorus fertility status for sugarcane. Under the high-phosphorus treatment 5, P.R. 903 yielded best of all, the other varieties giving significantly lower yields.

POTASSIUM.—P.R. 903 had the highest yields at the low-potassium level, followed by M. 317, and M. 275, P.O.J. 2878, in order. At the medium-potassium level, P.R. 903 was definitely superior, and P.O.J. 2878 and M. 317 had significantly higher yields than M. 275. At the high-potassium level P.R. 903 was first and the other three varieties were significantly lower in yield.

Applications of 150 pounds of K_2O per acre produced significant responses from P.O.J. 2878 and P.R. 903 whereas, 300 pounds of K_2O produced significant responses from M. 275 and M. 317.

Central Coloso Experiment

NITROGEN.—Variety P.R. 902 gave the highest yields for the low-nitrogen level, and yields of the other three varieties were all significantly lower. This did not hold true at the medium- and high-nitrogen levels, where P.R. 905 improved to the point where it and P.R. 902 were the highest yielders; M. 275 was next. M. 28 had significantly the lowest yields.

The use of 125 pounds of nitrogen per acre produced significant yield responses in all four varieties. However, only M. 275 and P.R. 905 responded significantly at the 250-pound level.

PHOSPHORUS.—No discernible response was obtained from phosphate fertilizer. In the fertility-level treatment 5, M. 28 was inferior to the other three varieties, all of which yielded about alike.

POTASSIUM.—At the low-potassium level, M. 275 was inferior to P.R. 902 with M. 28 and P.R. 905 showing intermediate ranking. At the medium-potassium level, M. 28 produced significantly lower yields than P.R. 905, and at the high-potassium level was significantly lowest of all.

All varieties except M. 28 responded significantly with increased yields to the application of 150 pounds of K_2O per acre. But only M. 275 and P.R. 902 produced further significant increases when 300 pounds of K_2O per acre were applied.

Colonia Constancia Experiment

NITROGEN.—Varieties B.H. 10(12) and P.O.J. 2878 were superior in yields to M. 275 and M. 28 at the low- and medium-nitrogen levels. At the high-nitrogen level, M. 275 and P.O.J. 2878 were superior to M. 28, and B.H. 10(12) was intermediate in yield.

All varieties responded positively to applications of 83 pounds of nitrogen per acre. Only M. 275 produced a significantly increased yield when 165 pounds of nitrogen per acre were applied.

PHOSPHORUS.—There was no significant yield response to phosphorus. At the high-phosphorus level, treatment 5, M. 28, had a significantly lower yield than did P.O.J. 2878 and M. 275

POTASSIUM.—No appreciable differences in yield of varieties were evident at the low-potassium level. M. 28 yielded least at the medium- and high-potassium levels.

Only M. 275 gave a significant and positive response to potash at all potassium levels. P.O.J. 2878 did respond significantly to an application of 100 pounds of K_2O per acre.

THE SEMIARID AREA

Isabela Substation Experiment

Results of the Isabela Substation experiment are shown in table 3.

NITROGEN.—P.R. 902 was superior to the other varieties in yields at the low-nitrogen level; P.R. 905 stood next; M. 28 and P.O.J. 2878 were definitely inferior to them. At the medium- and high-nitrogen levels, P.R. 905 about equalled P.R. 902 in yield, and both were superior to M. 28 and P.O.J. 2878.

Except for P.R. 902, all the varieties significantly increased in yield when 125 pounds of nitrogen per acre were used.

None of the varieties responded significantly to the use of 250 pounds of nitrogen per acre.

PHOSPHORUS.—P.R. 902 gave the highest yields at the low-phosphorus level, followed by P.R. 905, M. 28, and P.O.J. 2878, in order. As was the case with nitrogen, P.R. 905 increased in yield at the medium- and high-phosphorus levels so much that there P.O.J. 2878 had the lowest yields.

All varieties except P.R. 902 produced significantly increased yields when 150 pounds of P_2O_5 were used per acre, but none did so when 300 pounds P_2O_5 were applied.

POTASSIUM.—Potash had no significant influence on yields. It was assumed, therefore, that the potassium fertility of this soil was high. At the high-potassium level, treatment 5, P.R. 902 and P.R. 905, was superior to M. 28 and P.O.J. 2878 in yields.

TABLE 3.—*Comparison of the yields of sugarcane varieties at different fertilizer levels in the semihumid area, Isabela Substation experiment*

Treatment	Fertility level	Fertilizer treatment per acre of—			Yield of available 96° sugar per acre for—			
		N	P_2O_5	K_2O	M. 28	P.O.J. 2878	P.R. 902	P.R. 905
		Lb.	*Lb.*	*Lb.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*
1	Low N	0	300	300	59	51	96	80
2	Medium N	125	300	300	74	68	103	105
3	Low P	250	0	300	65	59	102	89
4	Medium P	250	150	300	78	71	111	101
5	High N, P, K	250	300	300	80	73	108	108

Least significant difference needed between fertilizer treatments for any one variety at:				
5-percent level	10	10	10	10
1-percent level	13	13	13	13
Least significant difference needed between varieties for any one fertilizer treatment at:				
5-percent level	11	11	11	11
1-percent level	14	14	14	14

ARID-NONIRRIGATED AREA

Lajas Experiment

The results of the Lajas Substation, arid-nonirrigated; Colonia Josefa, arid-irrigated; and the Central Aguirre, arid-irrigated experiments are shown in table 4.

NITROGEN AND PHOSPHORUS.—There was no significant responses in yield to the use of either nitrogenous or phosphatic fertilizers, and the soil-fertility status for these elements was regarded as high. B. 34104 was the leading variety with the other three decidedly inferior in yield.

POTASSIUM.—At all potassium levels B. 34104 was superior in yield to the other varieties. Some imporvement was shown by P.O.J. 2878 at the medium- and high-potassium levels, but only P.O.J. 2878 responded significantly in yield when 200 pounds of K_2O were applied.

TABLE 4.—*Comparison of the yields of sugarcane varieties at different fertilizer levels in the arid-nonirrigated and the arid-irrigated areas*

Lajas Substation, arid-nonirrigated

Treatment No.	Fertility level	Fertilizer treatment per acre of— N	P₂O₅	K₂O	Yield of available 96° sugar per acre for— P.O.J. 2878	P.R. 905	P.R. 902	B. 34104
		Lb.	*Lb.*	*Lb.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*
1	Low K	200	240	0	78	72	86	128
2	Medium K	200	240	120	105	84	80	143
3	High N, P, K	200	240	240	108	88	98	169
Least significant difference needed between fertilizer treatments for any one variety at:								
5-percent level					22	22	22	22
1-percent level					29	29	29	29
Least significant difference needed between varieties for any one fertilizer treatment at:								
5-percent level					28	28	28	28

Colonia Josefa experiment, arid-irrigated area

Treatment No.	Fertility level	N	P_2O_5	K_2O	P.O.J. 2961	B.H. 10(12)	P.O.J. 2878	M. 341
		Lb.	*Lb.*	*Lb.*	*Cwt.*	*Cwt.*	*Cwt.*	*Cwt.*
1	Low N	0	360	360	131	119	109	93
2	Medium N	100	360	360	153	151	142	124
3	High N	200	360	360	146	160	149	133
4	Very high N, P, K	300	360	360	154	149	132	137
Least significant difference needed between fertilizer treatments for any one variety at:								
5-percent level					22	22	22	22
1-percent level					29	29	29	29
Least significant difference needed between varieties for any one fertilizer treatment at:								
5-percent level					23	23	23	23

Central Aguirre experiment, arid-irrigated area

Treatment No.	Fertility level	N	P_2O_5	K_2O	Yield of cane per acre for— B.H. 10(12)	P.O.J. 2878
		Lb.	*Lb.*	*Lb.*	*Tons*	*Tons*
1	Medium N	125	300	400	36	37
2	High N	250	300	400	37	40
3	Very high N, P, K	375	300	400	42	45
4	Very high N	500	300	400	46	51
Least significant difference needed between treatments at:						
5-percent level					5	5
1-percent level					7	7

TABLE 4.—*Continued*

Central Mercedita experiment, arid-irrigated area

Treatment No.	Fertility level	Fertilizer treatment in pounds per acre of—			Yield of cane per acre for—	
		N	P_2O_5	K_2O	B.H. 10(12)	P.O.J. 2878
		Lb.	*Lb.*	*Lb.*	*Tons*	*Tons*
1	Low N	125	300	300	91	108
2	High N	250	300	300	91	111
3	Very high N, P, K	375	300	300	95	102
4	Very high N	500	300	300	100	109
Least significant difference needed between treatments at:						
5-percent level					5	5
1-percent level					7	7

ARID-IRRIGATED AREA

Colonia Josefa Experiment

NITROGEN.—At the low- and medium-nitrogen levels P.O.J. 2961 and B.H. 10(12) yielded better than M. 341, with P.O.J. 2878 intermediate between them. B.H. 10(12) had the highest yields at high-nitrogen levels and M. 341 had significantly lower yields than the other varieties. At the very high-nitrogen levels, yields of B.H. 10(12) and P.O.J. 2878 decreased, but P.O.J. 2961 yielded significantly more than P.O.J. 2878.

Applications of 100 pounds of nitrogen per acre produced significant yield increases in all varieties, but this was not true when 200 or 300 pounds of nitrogen per acre were used, as compared with yields at 100 pounds.

PHOSPHORUS AND POTASSIUM.—No significant responses in yields were obtained for either phosphate or potash fertilizers. The fertility status of the Machete clay loam in respect to these two elements may be assumed high.

Central Aguirre Experiment

NITROGEN.—P.O.J. 2878 outyielded B.H. 10(12) in cane per acre at all nitrogen levels. The differences in yields grew greater with increasing nitrogen applications. Significant yield increases were obtained when 375 pounds of nitrogen per acre were used, as compared with 250 pounds.

PHOSPHORUS AND POTASSIUM.—Phosphate and potash applications produced no significant increases in yield. These soils may be presumed high in phosphorus and potassium. P.O.J. 2878 had higher yields than B.H. 10(12).

Central Mercedita Experiment.

No significant yield differences were obtained at any fertility level for nitrogen, phosphorus, or potassium for the two varieties used, P.O.J. 2878 and B.H. 10(12). The average for all fertility levels was 108 tons of cane per acre for P.O.J. 2878, as compared with 98 tons for B.H. 10(12). P.O.J. 2878 outyielded B.H. 10(12) at all fertility levels.

DISCUSSION

It would be well now to review the three questions asked in the Introduction in light of our experimental results.

1. *Are the results of sugarcane-variety field trials valid for different fertility levels when they are performed at one fertility level?*

The experimental data indicate that many varieties do not tend to keep their relative rank at various fertility levels. A summary of the ranking of the varieties in respect to cane-yield responses for the various experiments is given in table 5. The results show that certain varieties which ranked low at a given fertility level, as compared with other varieties, yielded as well as the high-ranking varieties when grown at another fertility level. For example, if a plant breeder were conducting a sugarcane-variety trial at low-nitrogen levels as in the Central Coloso experiment, he would find that P.R. 902 alone was the statistically outstanding variety in yields (see tables 2 and 5). However, at medium-nitrogen levels he would find that P.R. 905 and P.R. 902 were the best. At high-nitrogen levels his data would show that there were no significant yield differences between P.R. 902, P.R. 905, and M. 275, and all three would outyield M. 28 significantly.

This change in rank at various fertility levels occurred also for nitrogen and potassium in the Colonia San Francisco experiment, phosphorus in the Central Coloso experiment, nitrogen and potassium in the Colonia Constancia experiment, nitrogen and phosphorus in the Isabela Substation experiment, and nitrogen in the Colonia Josefa experiment. Van Dillewijn (2)[2] also reported evidence from both Java and Hawaii that certain cane varieties revealed a differential response to fertilizers at various fertility levels.

From the data presented it appears that, when variety trials are made at one fertility level, this alone may obscure the selection of certain promising varieties which might perform as well as, or better than, those chosen at another fertility level. This change in ranking with change in fertility level may help explain why a variety which has shown high rank in a variety trial sometimes fails to give good results when recommended for commercial use where conditions of soil fertility are not the same as those under which the trial was conducted.

[2] Numbers in parentheses refer to Literature Cited, p. 143.

TABLE 5.—*The ranking of certain sugarcane varieties with respect to cane-yield responses at different fertility levels*[1]

Experiment and variety	Cane-varietal rank at indicated fertility levels								
	Nitrogen			Phosphorus			Potassium		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
Colonia San Francisco experiment									
P.R. 903	1	1	1	—	—	1	1	1	1
P.O.J. 2878	1	2	2	—	—	2	2	2	2
M. 317	2	2	2	—	—	2	1	2	2
M. 275	2	2	2	—	—	2	2	2	2
Central Coloso experiment									
P.R. 902	1	1	1	—	—	1	1	1	1
P.R. 905	2	1	1	—	—	1	1	1	1
M. 28	2	3	2	—	—	2	1	2	2
M. 275	2	2	1	—	—	1	2	1	1
Colonia Constancia experiment									
B.H. 10(12)	1	1	1	—	—	1	1	1	1
P.O.J. 2878	1	1	1	—	—	1	1	1	1
M. 28	2	2	2	—	—	2	1	2	2
M. 275	1	2	1	—	—	1	1	1	1
Isabela Substation experiment									
P.R. 902	1	1	1	1	1	1	—	—	1
P.R. 905	2	1	1	2	1	1	—	—	1
M. 28	3	2	2	3	2	2	—	—	2
P.O.J. 2878	3	2	2	3	2	2	—	—	2
Lajas Substation experiment									
B. 34104	—	—	1	—	—	1	1	1	1
P.O.J. 2878	—	—	2	—	—	2	2	2	2
P.R. 902	—	—	2	—	—	2	2	2	2
P.R. 905	—	—	2	—	—	2	2	2	2
Colonia Josefa experiment									
P.O.J. 2878	1	1	1	—	—	1	—	—	1
P.O.J. 2961	1	1	1	—	—	1	—	—	1
B.H. 10(12)	2	2	2	—	—	2	—	—	2
M. 341	2	1	1	—	—	1	—	—	1

[1] All differences between any ranking are statistically significant at the 5-percent level.

2. *Is it necessary to run fertilizer field trials on new varieties?*

In view of the experimental data obtained it appears that the use of one variety only to determine soil fertility, fertilizer responses, or cane fertilizer requirements may be misleading. For instance, results obtained in the humid area (table 2) on the nitrogen requirements of cane revealed that all varieties responded significantly to the first nitrogen increment from low-nitrogen to medium-nitrogen fertility levels. However, when the second nitrogen increment is considered, from medium-nitrogen to high-nitrogen levels, there were differences in the responses attributable to varieties. In the Coloso experiment M. 275 showed a significant response in yield whereas the others did not (table 2, treatment 2 versus treatment 5). In the Constancia experiment M. 275 also responded to a second increment of nitrogen, whereas B.H. 10(12) and M. 28 failed to do so.

Similar difference in variety response to a given fertilizer application was noted for the other areas, and for all three elements, nitrogen, phosphorus, and potassium. Therefore, fertilizer recommendations based on experiments with one variety may not necessarily be valid for new varieties. To obtain more precise information on the fertilizer requirements of sugarcane it may be necessary to perform fertilizer field trials for the leading varieties, rather than to base recommendations on the performance of any one variety in a fertilizer test.

3. *Should certain sugarcane varieties be recommended for soils of low fertility and different varieties for soils of medium or higher fertility?*

The data obtained indicate that some varieties do not tend to maintain their yielding rank at various fertility levels. The recommendation of a variety which has ranked high at medium- or high-fertility levels may not necessarily be the wisest choice for a soil of a low fertility level. For example, at the Isabela Substation, P.R. 905 gave an outstanding performance at medium- and high-nitrogen levels, but was only second to P.R. 902 at low-nitrogen levels (see table 5). For soils of medium- or high-nitrogen fertility in that area P.R. 902 or P.R. 905 would both be suitable. Only P.R. 902 should be recommended where low-nitrogen levels are encountered. Therefore, it appears that certain varieties do perform comparatively better than others at different fertility levels.

CONCLUSIONS

In general, there is some interaction between sugarcane varieties and fertilizers. A summary of the interactions and their significance for the eight experiments is given in table 6. In three of the eight experiments there were statistically significant interactions between variety and fertilizer.

Low or no interaction between fertilizer and variety has been found for such crops as sugar beets (5), potatoes (3), and peanuts (6), whereas, significant interactions were noted between variety and fertility levels for corn and wheat. Frey (4) has suggested that, in general, crops in which one variety has a small area of adaptation, corn, for example, tend to show a significant variety-by-fertility-level interaction, while crops in which any one variety has a large area of production, such as oats, do not show such significant interactions.

Sugarcane varieties are normally grown over wide areas; however, certain varieties developed in one geographic area appear to do better in there than elsewhere. Davidson (1), using selected varieties of the sugarcane areas in Louisiana, mainly Canal Point varieties, did find significant variety-by-fertility interactions.

The sugarcane varieties commercially used in Puerto Rico are of both types. In 1949 over 65 percent of the cane planted was P.O.J. 2878, with B.H. 10(12) accounting for 15 percent (7). The P.O.J. 2878 variety is grown

TABLE 6.—*The F value and significance for varieties, fertilizers, and variety-fertilizer interactions for the cane experiment evaluated herein*[1]

Experiment	Crops	Variety F value	Fertilizer F value	Variety fertilizer interaction F value
	Number			
1. Colonia Constancia	1	5.01*	82.67**	2.21**
2. Colonia San Francisco	5	17.23**	180.68**	3.19**
3. Central Coloso	4	13.03**	94.16**	1.95
4. Isabela Substation	4	86.53**	84.90**	.91
5. Lajas Substation	1	11.09**	2.79**	1.34
6. Colonia Josefa	1	26.24**	8.09**	.72
7. Central Aguirre	1	14.71**	5.45**	.90
8. Central Mercedita	1	59.30**	.75	2.01**

[1] * Significant difference at the 5-percent level, ** significant difference at the 1-percent level.

over wide areas and is not restricted in its response to any one. However, B.H. 10(12) has shown a better response in the irrigated southern coast than in the humid northern coast.

Soil fertility is a product not only of the nutrient elements present in it, but also of such factors as rainfall, drainage, depth of soil profile, temperature, and soil texture, Therefore, differences in soil fertility do exist for different sugarcane areas. These differences do not evoke the same response for all sugarcane varieties. Whereas some varieties may acclimate themselves and perform well at many fertility levels under a wide range of climatic conditions, other varieties tend to be more selective in their soil-fertility and climatic needs and to perform much better in some places than in others. Thus it appears important that adequate consideration be given to the influence of fertility on varietal response in sugarcane when testing new sugarcane varieties.

SUMMARY

There are many as yet unanswered questions concerning the relationship between sugarcane varieties and soil fertility. Important among them are the following:

1. Are the results of sugarcane-variety field trials valid for different fertility levels when performed at but one fertility level?
2. Is it necessary to run fertilizer field trials on new varieties?
3. Should certain sugarcane varieties be recommended for soils of low fertility and different varieties for soils of medium or higher fertility?

Statistical examination of the data from eight variety-fertilizer experiments carried on in different parts of Puerto Rico: Humid, semihumid, arid-irrigated, and arid-nonirrigated, and also on different soil types, revealed the following answers to these questions concerning differences in varietal response to different fertility or fertilizer levels, using nitrogen, phosphorus, and potassium:

1. Certain varieties did not consistently yield best at all fertility levels.
2. Some varieties appeared to do better at higher fertility levels than at low ones; others performed better at low fertility levels.
3. Inasmuch as varietal response is different at various fertility levels, caution is recommended in evaluating new variety trials at only one fertility level.
4. Not all varieties responded similarly to fertilizer applications, and it would be misleading to define fertilizer requirements or the fertility level on the basis of the performance of one cane variety only, if other varieties are to be grown in that area.
5. A discussion of the interaction of varieties and fertilizers is presented in which it is suggested that some cane varieties developed in one geographic area do better there than elsewhere, while other varieties grow well over wide areas.

RESUMEN

El examen estadístico de los datos obtenidos de ocho experimentos en los cuales se usaron distintas variedades de caña de azúcar y distintos tratamientos de abonos, y llevados a cabo en zonas húmedas, semi-húmedas, áridas con y sin riego, de Puerto Rico, así como también en varios tipos de suelos, reveló que las variaciones observadas en la producción de las variedades, respecto al uso variable de nitrógeno, fósforo y potasio, pueden resumirse de la manera siguiente:

1. Algunas variedades no produjeron consistentemente bien en todos los niveles de fertilidad estudiados.
2. Algunas variedades respondieron mejor a niveles altos de fertilidad

que a niveles bajos; mientras que otras, su comportamiento fué todo lo contrario.

3. Tomando en consideración la reacción versátil de las variedades a los distintos niveles de fertilidad, se discute en el presente trabajo las precauciones que deben tomarse al llevar a cabo futuros experimentos con abonos.

4. Todas las variedades no reaccionan igualmente al uso de abonos y por lo tanto sería incorrecto el determinar los requisitos de los mismos a base del comportamiento de una sola variedad.

5. Se presenta una exposición de la acción recíproca ocurrida entre las variedades y los fertilizantes lo cual lleva a suponer que algunas variedades se comportan mejor que otras en cierta y determinada región, mientras que otras se desarrollan espléndidamente en distintas regiones.

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