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PREHARVEST FOLIAGE SPRAYS OF SUGARCANE WITH 2,4-D

M. A. Lugo-López and R. Grant[1]

Introduction

Sugarcane is the major cash crop of Puerto Rico. Crop net income, other factors being constant, depends on sugar yields and therefore, on cane tonnage and sucrose content. Considerable work has been done in an effort to increase yields through the use of better varieties, improved fertilizer practices, and adequate cultivation. However, the variability which can be observed in sugar yields is still rather large, with many extremely low levels. Although efforts have been directed towards finding the fundamental facts underlying the variations in sugar production, many gaps remain to be filled.

The possibility of increasing sugar yields through the use of hormones has been considered only lately (3).[2] The hormone most used, so far, has been 2,4-D (monohydrate dichlorophenoxyacetic acid). The use of 2,4-D and other hormones in lethal concentrations as herbicides in the early stages of the cane crop is a generalized practice in most Puerto Rican cane fields. Considerable progress has been made in recent years through research conducted locally and abroad, and centered mostly around the physiological action of the chemicals as weed-killers, their selective action upon various species of plants, movement in the soil, injurious effects to the crop, etc.

This paper reports on preliminary work conducted in Puerto Rico to test the effects of preharvest foliage sprays on sugarcane with 2,4-D on the final sucrose yields of the cane.

Theoretical Considerations

The purpose of this work was to obtain preliminary information on the influence of hormones on the sucrose content of the cane. An overdose of the selected growth regulator was used intentionally with the idea of

[1] Associate Soil Scientist and formerly Research Assistant in Agronomy in charge of the Station farm, respectively, Agricultural Experiment Station, University of Puerto Rico, Río Piedras, P. R.

[2] Numbers in parentheses refer to Literature Cited p. 193.

offsetting the metabolic processes of the sugarcane plant at a time approaching the harvesting season. It was hoped that such a change would result in the conversion of starches in the green leaf section of the stalk, and in the leaves, into sucrose, with a consequent increase in the final sucrose accumulation of the millable cane. About the time this work began, several reports appeared from abroad concerning the role of 2,4-D applications in relation to final sucrose accumulation (1, 2, 3).

Beauchamp (1) conducted various experimental trials followed by large-scale tests at different locations in Cuban plantations using 2,4-D to hasten the maturity of the sugarcane plant, using the varieties POJ 2878 and Media Luna 3/18. His reports indicate that dusting the cane foliage with 4 to 6 ounces to the acre of the sodium salt of 2,4-D produced a significant increase in sugar yields during the first 10 days following the application. Beauchamp reported increases in sucrose of 1.4 and 2.0 percent from the application of 2,4-D, 10 days prior to harvest. His results seem to be rather consistent considering the large area covered in his various experimental and large-scale trials. Almost invariably all treated plots yielded more sucrose than the control plots. Other reports from Louisiana and elsewhere have pointed to increased sucrose from 2,4-D applications (3). Loustalot, et al (2), from experimental work at Mayagüez, concluded that spraying M 336 sugarcane with 0.2-percent isopropyl ester of 2,4-D prior to harvesting had no significant effects on sugar yields. In view of these apparently contradictory reports concerning the role of 2,4-D on sugar yields and of the importance of the problem further work seemed necessary.

About the time that the preliminary work reported here was concluded, a report from Wort in British Columbia (4), indicated that increases of total sugars in the stem of buckwheat were obtained after applications of small, nonlethal concentrations of the ammonium salt of 2,4-D, 50, 100, 500, and 1,000 parts per million. Total sugars in the stems and leaves rose considerably within 1 day after the application, but fell again by the second day.

Experimental

Two fields were selected, one at the Solís farm of the Agricultural Experiment Station at Río Piedras and one at Colonia Mandry of the Eastern Sugar Associates, near Central Pasto Viejo at Humacao. Both fields have been planted to POJ 2878 and about 14 ratoon crops harvested following the original planting of cane. At Río Piedras the soil has been classified as Vega Alta clay loam, a rather extensive, level sugarcane soil of the north coastal region. At Humacao the soil was originally a muck at a very low level which had been reclaimed from the sea, and had undergone considerable mineralization. Both fields were divided into 6 blocks with 10

plots each. The area of the plots was about 0.01 acre and they were nearly square in shape. A row of cane was cut around each plot and 2 rows were left standing between every 2 plots to serve as buffer strips. Between each 2 plots there was a 20-foot separation. The row of cane eliminated around each plot provided a very convenient pathway to facilitate spraying operations, (fig. 1). The experimental design followed a randomized block lay-out with 10 treatments, each replicated 6 times.

The treatments were as follows: Check, 10, 20, and 30 pounds to the acre of the sodium salt of 2,4-D, acid basis, applied 10, 20, and 30 days prior

FIG. 1.—Pathway prepared by cutting one row of cane between the experimental plots and the buffer strips to facilitate spraying operations.

to harvesting the cane. The larger concentrations used were intended to evoke a drastic change in the metabolism of the sugarcane plant. A common knapsack sprayer was used and the required quantity of the salt was dissolved in 1 gallon of water which was enough to spray thoroughly the cane in each plot. An extension was attached to the hose and the nozzle was tied to a bamboo pole 12 or 14 feet in length which could be raised well above the cane to permit the spray to fall on the cane foliage (fig. 2). The spraying operations were started about 6:00 A.M. to avoid violent drafts and thus minimize the error in spraying. Ten days after the last

treatment the cane was harvested from all plots and weighed in the field. Samples of 25 canes each were obtained from each plot at random and taken to the Station mill at Río Piedras. After grinding, the juice was

FIG. 2.—By using a bamboo pole 12 to 14 feet long, to which an extension to the hose of the sprayer was attached, it was possible easily to reach the foliage of the cane plants.

sampled and analyzed for Brix and polarization. From that data the purity and available 96° sugar percent cane were then calculated.

PRESENTATION OF DATA AND DISCUSSION

Table 1 gives a summary of the experimental data obtained at Humacao and Río Piedras, respectively. At Humacao the Brix values ranged from

18.9 to 20.6. The mean difference required for significance is 1.8. The mean polarization for juices ranged from 70.8 to 75.6, but the differences are not significant. The mean available 96° sugar percent cane was 12.2 for all combined treatments with deviations of only 0.5 percent above or below it. No significant differences were observed between the mean of

TABLE 1.—*Mean values for Brix, polarization, purity, available 96° sugar percent cane, and yield per acre of cane treated with 3 different concentrations of 2,4-D at 3 dates prior to harvest*

Days prior to harvest	2,4-D per acre	Brix	Polarization	Purity	Available 96° sugar percent cane	Cane per acre
			Results at Humacao[1]			
	Pounds	*Degrees*	*Degrees*	*Percent*		*Tons*
10	10	19.6	74.9	89.6	12.7	38.71
10	20	19.7	74.3	87.1	11.9	43.63
10	30	20.1	74.2	87.7	12.3	45.05
20	10	20.4	75.6	88.0	12.6	43.23
20	20	19.4	70.8	86.7	11.8	39.58
20	30	19.3	72.6	87.1	12.4	41.23
30	10	19.9	72.2	86.4	12.0	44.35
30	20	18.9	73.2	86.4	12.1	44.93
30	30	19.8	72.3	86.5	12.2	41.40
	0	20.6	75.6	86.9	12.5	43.06
			Results at Rio Piedras[2]			
10	10	20.2	73.4	85.6	12.3	28.02
10	20	19.7	71.7	85.9	12.1	28.68
10	30	19.9	72.2	85.6	12.2	30.26
20	10	20.0	72.4	84.3	12.3	25.87
20	20	19.7	71.2	87.8	12.0	28.58
20	30	19.8	71.8	85.4	12.1	24.24
30	10	20.1	72.8	85.4	12.3	29.66
30	20	19.9	71.8	85.9	12.0	25.58
30	30	19.7	71.4	85.6	12.0	27.83
	0	20.1	73.3	86.4	12.4	27.70

[1] Minimum required for significance: Brix 1.8, polarization 5.8, purity 4.3, sugar percent cane 1, cane per acre 10.38.

[2] Minimum required for significance: Brix 0.7, polarization 3.4, purity 2.4, sugar percent cane 0.7, cane per acre 7.75.

treatments for available 96° sugar percent cane, purity, and tons of cane to the acre.

The results of the Río Piedras experiment follow about the same pattern as those from Humacao. The mean available 96° sugar percent cane for all combined treatments was 12.2, with maximum deviations of only 0.2

above or below it. In general, the differences between the means for Brix, polarization, purity, available 96° sugar percent cane, and tons of cane to the acre are not significant.

This preliminary attempt to offset the metabolism of the sugarcane plant at harvesttime was not successful. Perhaps the application of large doses of 2,4-D do not affect the metabolic activity of the cane plant as do smaller doses such as those used by Beauchamp (1). However, other factors may be of importance, such as the physical properties of the chemical used. In the literature available there is no mention to anything concerning the pH, wetability, rate of absorption by the plant, and other such properties of the chemical used, which in all probability have a tremendous importance in the final results obtained.

Additional work is under way to determine daily fluctuations, if any, in Brix, polarization, purity, and sucrose content of the cane after applications of 2,4-D. Smaller doses of 2,4-D will be applied and the changes in sucrose content will be traced daily for a certain period. Further work is contemplated with other growth regulators using a wide range of concentrations. The physiologic changes induced in the cane plant by preharvest foliage sprays with hormones should be investigated also. The careful study of the physiochemical properties of the materials used should help to clarify some of the fundamental concepts involved.

Summary

Data are presented here on the effect of applications to sugarcane of 10, 20, and 30 pounds to the acre of the sodium salt of 2,4-D, acid basis, at three intervals (10, 20 and 30 days) prior to harvest. Field experiments were conducted at Humacao and Río Piedras following a randomized block layout. Each treatment was replicated six times. The mean available 96° sugar percent cane was 12.2 at both locations with very small deviations above or below it. No significant differences were observed between the mean Brix, polarization, purity, available 96° sugar percent cane, and tons of cane to the acre at either location.

Resumen

Se presentan en este trabajo los datos obtenidos después de aplicar 10, 20, y 30 libras de la sal de sodio 2,4-D, base ácida, por acre, en tres períodos distintos (10, 20, y 30 días), antes de cosechar dos experimentos con caña de azúcar que se establecieron en Humacao y Río Piedras.

Estos experimentos de campo se establecieron siguiendo el diseño experimental de bloques al azar, con seis repeticiones por tratamiento.

La producción de sacarosa fué 12.2 por ciento, en promedio, con ligeras

desviaciones, tanto en el experimento en Humacao como en el de Río Piedras.

No hubo diferencias significativas entre los valores promedio de Brix, en la polarización, ni en la pureza, y tampoco en la sacarosa. No se registró diferencia alguna en el tonelaje de caña producido por acre en ambos experimentos.

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