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. LXI OCTOBER 1977 No. 4

Evaluation of Sugarcane Chemical Ripeners Mon 0139 and 2139 (Monsanto) in a Small-Plot Field Experiment[1]

G. Samuels and S. Alers Alers[2]

ABSTRACT

Growth and ripening effects of Mon 0139 and 2139 and Polaris (glyphosine) were examined on sugarcane variety PR 980 in a field experiment on the north coast of Puerto Rico. The materials (Mon 0139 and 2139 at 0.1, 0.3, and 1.0 lb/acre and Polaris at 3.5 and 4.5 lb/acre were applied in December at the beginning of the harvest season, when environmental conditions were unfavorable for natural ripening. Mon 2139 at 1.0 lb/acre applied 8 weeks prior to harvest gave significant increases in sucrose-percent-cane as compared to both Polaris and the control. There were no significant differences in performance between Mon 0139 and 2139, but both compounds gave increases in sucrose at 0.10 lb/acre, comparable to Polaris at the 3.5 lb/acre level. Phytotoxicity was evident at the 1.0 lb/acre rate of both compounds, and significant decreases in both growth and weight of cane tops were noted at this level. However, there was no residual growth suppression in the subsequent ratoon.

INTRODUCTION

The enhancement of the natural ripening of sugarcane by chemical compounds has become a proven fact with commercial acceptance by many growers. Polaris[3] (glyphosine) developed by Monsanto has become the accepted standard ripening agent in many sugarcane areas of the world. In Puerto Rico, it received greenhouse (3) and field evaluation (6) by the Station from 1970–72, giving significant increases in sucrose.

Monsanto recently presented two new candidates ripeners, Mon 0139

[1] Manuscript submitted to Editorial Board February 22, 1977.

[2] Agronomist and Associate Agronomist, respectively, Agricultural Experiment Station, University of Puerto Rico, Mayagüez Campus, Río Piedras, P.R. This work was financed by a research grant from Monsanto Agricultural Products Co., St. Louis, Mo. The authors acknowledge the excellent cooperation of Mr. Pedro Rodríguez and Héctor de Busto of the Northern Research Center, Arecibo, of the Sugar Corporation of Puerto Rico.

[3] Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of equipment or materials by the Agricultural Experiment Station of the University of Puerto Rico or an endorsement over other equipment or materials not mentioned.

and Mon 2139, for preliminary field evaluation under Puerto Rican sugarcane growing conditions. Previous greenhouse evaluation as CP 70139 (1, 2) had shown Mon 0139 to have excellent proficiency as a chemical ripener when compared to Polaris. The compounds were to be evaluated in a small-plot field experiment at the start of the 1976 harvest season when environmental conditions are normally unfavorable for natural ripening. The study described herein reports the results of this field evaluation of Mon 0139 and Mon 2139 as to growth and ripening activity.

MATERIALS AND METHODS

A replicated small-plot field experiment was established at the Tiburones Farm, Central Cambalache, Arecibo, on the north central coastal plain of Puerto Rico. This is a humid sugarcane area with an average annual rainfall of 56 in. The crop selected was a first ratoon of PR 980, a late-maturing, heavy-tonnage variety known to respond to sugarcane ripeners. The period of application selected was at the beginning of the harvest season on the increasing phase of the ripening curve. At this time natural ripening is retarded due to immature cane that has not, as yet, fully ripened because of high moisture content from the autumn rains and residual soil nitrogen.

The Mon 0139 and Mon 2139 treatments were applied separately at rates of 0.1, 0.3, and 1.0 lb acid equivalent/acre. Polaris treatments were applied at 3.5 and 4.5 lb (85% active ingredients)/acre as comparative standards, together with a no-spray control treatment. All applications were made between 0630 and 0900.

The experiment consisted of nine treatments replicated three times in a randomized block design. The individual plots consisted of five rows 25 ft long separated by two border rows between plots and 10 ft of unsprayed row at the end of each plot. The material was applied above the cane canopy through a single wide-angle nozzle mounted on a 15-ft lance. Each plot had three fully-sprayed and two half-sprayed rows. Drift was minimized by spraying before 0900 h. The volume of water used was equivalent to 50 gal/acre. This volume of spray required two passes. Chevron S-77 at 1/100 gal was used as the surfactant.

Materials were administered on December 3, 1975 when the cane was 9 months of age. Samples of cane stalks were taken at −1 day, and 2, 4, 6, and 8 weeks after application. The three fully-sprayed center rows of the plot were used for sampling. Each sample consisted of nine whole canes with tops, taken from stools selected by random numbers assignment. The samples were weighed with and without tops. The stalks were chopped in a silage cutter and an aliquot frozen for "pol-ratio" analysis (4).

Growth measurements were recorded 1 week prior to chemical application and at bi-weekly intervals thereafter for 8 weeks. Nine stalks, three per row of the three center rows, were used, with growth being measured in cm from the top visible dewlap to a point on the stalk 50 mm below, marked with tape as the reference point for all future measurements.

All sucrose-component values were adjusted by regression analyses for the initial plot variations at −1 day of application.

RESULTS AND DISCUSSION

WEATHER

Temperatures during the experiment were normal and showed decreasing values during the months of November, December, and January (table 1). Rainfall, however, was above normal giving rise to conditions quite unfavorable to natural ripening. On the day of application, which was very cloudy, 0.10 in of rain fell as light showers about 2 hours after the spray applications. For the first sampling period, covering 0 to 2 weeks after spraying, rainfall was 10.10 in, including 0.45 in falling on the day of sampling. The soil was saturated with moisture and all field drains were flooded. The second sampling covering the 3- and 4-week period had 3.75 in of rain with 0.40 in

TABLE 1.—*Rainfall and temperature data for sugarcane ripeners Mon 0139 and 2139*

Number of weeks before (−) and after application	Rainfall	Temperature		
		Maximum	Minimum	Mean
	In	*°F*	*°F*	*°F*
−4	3.00	88	68	78
−3	.60	88	67	78
−2	.40	88	68	78
−1	.25	86	68	77
1	3.15 (0.10)[1]	83	67	75
2	6.95 (0.45)[2]	83	68	76
3	2.55	83	64	74
4	1.20 (0.40)[2]	83	65	74
5	.20	86	62	74
6	.10 (0)[2]	85	62	74
7	.80	86	61	74
8	0 (0)[2]	85	62	74
4 weeks before	4.25	88	68	78
8 weeks after	14.95	84	64	74

[1] Ripeners applied. Rainfall on day of application given in parenthesis.
[2] Harvest sample. Rainfall on day of harvesting given in parenthesis.

falling the day of sampling. These adverse conditions plus the young age of the cane were reflected in the low sucrose percent cane values of 4.09 and 2.34 at 2 and 4 weeks, respectively, after application for the control treatment. For the last two sampling periods, covering weeks 5 to 8, rainfall had diminished and natural ripening had begun again.

SUCROSE-PERCENT-CANE

Mon 0139 and Mon 2139 each produced significant increases in sucrose from 4 to 8 weeks after application (table 2). At 4 weeks after application the sucrose increases were significant over the no-treatment

TABLE 2.—*Evaluation of sugarcane ripeners Mon 0139 and 2139 for sucrose content in cane*

Treatment	Rate	Sucrose in cane			
		Interval between application and harvest—weeks			
		2	4	6	8
	Lb/acre[1]	%	%	%	%
1. Control		4.09	2.34	4.79	6.83
2. Polaris	3.5	3.42	3.85	4.58	6.19
3. Polaris	4.5	4.09	4.05	4.38	7.26
4. Mon 0139	.1	4.07	4.34	4.42	6.68
5. Mon 0139	.3	4.77	4.65	5.63	7.25
6. Mon 0139	1.0	4.28	5.31	5.66	7.99
7. Mon 2139	.1	3.89	3.79	4.93	6.29
8. Mon 2139	.3	3.42	3.50	4.82	6.43
9. Mon 2139	1.0	4.34	5.10	6.26	9.24
Significant differences between treatments at the 5% level		2–5	1–3	2–9	1–6, 1–9
				3–9	2–6, 2–9
		5–8	1–4		3–9,
			1–5	4–9	4–6, 4–9
			1–6		5–9
			1–9		6–7, 6–8
			6–8		7–9, 8–9

[1] All rates except Polaris are based on pounds acid equivalent.

control, but not over the Polaris treatments. At 6 weeks after application, the Mon 2139 at 1.0 lb/acre was significant over the Polaris treatments. At 8 weeks after application, Mon 0139 and Mon 2139 at 1.0 lb/acre exceeded significantly the control and 3.5 lb/acre Polaris treatments.

A comparison of Mon 0139 and Mon 2139, reveals that there was no significant difference between them at the same given level of application. Both compounds were significant at the 1.0 lb/acre level as compared to the 0.3 and 0.1 levels.

The increases in sucrose-percent-cane were greatest at 4 weeks after application for all three ripeners. The 4-week interval recorded the lowest sucrose value in the control treatment for the whole experiment, 2.34 sucrose-percent-cane. The average sucrose value for the experiment at −1 day of application was 3.89%. This very low value may have reflected the accumulative effect of heavy rains during the first 4 weeks of the experiment.

Both candidate ripeners, compared to the Polaris standard, showed superior increases in sucrose levels at much lower rates of application. To produce ripening action similar to Polaris, 0.1 lb/acre of Mon 0139 or

TABLE 3.—*Growth of cane treated with sugarcane ripeners Mon 0139 and 2139*

Treatment	Rate	Growth per 2-week intervals after application				
		0–2	2–4	4–6	6–8	0–8
	Lb/acre[1]	*Cm*	*Cm*	*Cm*	*Cm*	*Cm*
1. Control		10.7	8.7	10.0	15.0	44.4
2. Polaris	3.5	9.7	7.7	10.0	13.3	40.7
3. Polaris	4.5	7.3	6.7	6.3	7.0	27.3
4. Mon 0139	.1	6.7	7.7	8.3	16.3	39.0
5. Mon 0139	.3	6.3	9.0	6.0	8.3	29.7
6. Mon 0139	1.0	6.6	5.0	2.7	2.7	17.0
7. Mon 2139	.1	7.0	8.0	8.0	9.7	32.7
8. Mon 2139	.3	8.7	6.0	6.7	6.7	28.0
9. Mon 2139	1.0	5.3	4.3	1.0	3.3	14.0
Significant differences between treatments at the 5% level		1–4	1–6	1–6		1–3, 1–5
		1–6	1–9	2–6		1–6, 1–8
		1–9	5–6	4–9	4–6	1–9, 2–3
		7–9	5–9	7–9	6–9	2–6, 2–9
		1–5		1–9		3–9
		1–7		2–9		4–6
		2–9				4–9, 5–6
						5–9, 6–7
						7–9, 8–9

[1] All rates except Polaris are based on pounds acid equivalent.

Mon 2139 was equivalent to 3.5 lb/acre of Polaris. Mon 0139 and Mon 2139 were about 35 times more efficient than Polaris in producing the same degree of ripening. Alexander (2) in a greenhouse experiment found Mon 0139 at 100 p/m was equivalent to Polaris at 900 p/m (and in certain treatments at 2700 p/m) in ripening action at 4 weeks after application.

Results similar to those found for sucrose-percent-cane for Mon 0139 and Mon 2139 were obtained for other sucrose components: sucrose-percent-juice, polarization, Brix, and purity.

GROWTH

The growth and appearance of the cane were affected by applications of Mon 0139 and Mon 2139. Visual symptoms of chlorosis on the leaves were evident at 4 weeks after application with the 1.0 lb/acre rate. At 8 weeks after application, there was a distortion of the new leaves as well as production of side-shoots (lalas). Growth was suppressed as early as 2 weeks after application for Mon 0139 and Mon 2139 at all rates (table 3). For the 8-week period from application to harvest,

TABLE 4.—*Influence of sugarcane ripeners Mon 0139 and 2139 on cane top weights*

Treatment	Rate	Weight of Cane Tops			
		Interval between application and harvest—weeks			
		2	4	6	8
	Lb/acre[1]	*Lb*	*Lb*	*Lb*	*Lb*
1. Control		7.5	7.0	7.2	8.6
2. Polaris	3.5	7.5	7.3	5.6	7.4
3. Polaris	4.5	6.2	5.5	5.8	7.1
4. Mon 0139	.1	6.7	8.5	11.4	8.2
5. Mon 0139	.3	6.1	6.9	5.2	7.4
6. Mon 0139	1.0	6.8	3.9	6.7	6.2
7. Mon 2139	.1	6.8	4.9	8.7	7.8
8. Mon 2139	.3	7.0	5.4	6.7	8.9
9. Mon 2139	1.0	6.0	6.6	2.5	5.5
Significant differences between treatments at the 5% level			1-6 2-6 3-4 4-6 4-7 4-8	1-4, 1-9 2-4, 2-7 2-9, 3-4 3-7, 3-9 4-5 4-6, 4-7 4-8, 4-9 5-7, 5-9 6-9 7-9 8-9	1-6, 1-9 2-9, 3-8 3-9 4-6 4-9, 5-9 6-8 8-9 6-7 7-9

[1] All rates except Polaris are based on pounds acid equivalent.

growth was significantly suppressed at the 0.3 and 1.0 lb/acre rate for both compounds and at the 4.5 lb rate for Polaris. The weight of cane tops at each harvest also revealed growth suppression by Mon 0139 and Mon 2139 at 6 and 8 weeks after application at the 1.0 lb/acre rate (table 4).

Ratoon measurements taken at 3 months after harvest revealed no significant differences in plant height, weight, or number of plants per linear foot (table 5).

TABLE 5.—*The influence of sugarcane ripeners Polaris, Mon 0139, and 2139 on the growth of the subsequent ratoon crop at 3 months*

Treatment	Amount per acre	Plant height	Plants per linear foot	Weight per plant
	Lb	*Cm*	*No.*	*G*
Control	0	59	6.9	33.2
Polaris	3.5	54	8.7	24.6
Polaris	4.5	60	7.5	31.7
Mon 0139	.1	59	7.2	29.1
Mon 0139	.3	53	7.8	24.0
Mon 0139	1.0	62	9.2	30.5
Mon 2139	.1	61	8.6	32.8
Mon 2139	.3	62	9.6	27.3
Mon 2139	1.0	50	10.1	24.8

Foliar analyses of the cane leaves at the 8-week harvest showed low N values (average 1.09% N dry weight basis) for all treatments, indicating that N was not a limiting factor in the ripening of the cane. However, leaf sheath moisture values averaged 79%, suggesting that excess soil moisture was still a limiting factor in ripening. A leaf sheath moisture of less than 74% is associated with natural cane ripening (5).

Mon 0139 and Mon 2139 produced ripening action in sugarcane under adverse conditions for natural ripening at levels much lower than those of Polaris. However, phytotoxicity and suppression of growth of the two former agents indicate that further research is needed to determine rates which can achieve maximum ripening activity at minimal levels of injury to the cane.

RESUMEN

En un experimento de campo en la costa norte de Puerto Rico, se estudió el effecto de los compuestos Mon 0139, 2139 y Polaris (glyphosine) sobre el crecimiento y la madurez de la variedad PR 980 de caña de azúcar.

Se aplicaron 0.1, 0.3 y 1.0 libra por acre de Mon 0139 y 3.5 y 4.5 libras por acre de Polaris. Los compuestos se aplicaron en diciembre, a principio de la cosecha, cuando las condiciones ambientales eran desfavorables para la madurez natural. El Mon 2139 aplicado 8 semanas antes de la cosecha a razón de 1.0 libra por acre produjo resultados significativos en porcentaje de sacarosa al compararlo con Polaris y con el control. No hubo diferencias significativas en el comportamiento entre Mon 0139 y 2139; ambos compuestos a razón de 0.10 libra por acre aumentaron la sacarosa a nivel comparable con Polaris a razón de 3.5 libras por acre. A razón de 1 libra por acre la fitotoxicidad de ambos compuestos fue evidente, y el crecimiento y el peso de la parte superior del tallo disminuyeron significativamente. Sin embargo, no hubo efecto residual en las cosechas subsiguientes.

LITERATURE CITED

1. Alexander, A. G., Ripening proficiencies of Polaris, CP 70139, RH 1622, Ripenthol and PP757, in early-adult sugarcane, J. Agric. Univ., P.R. 60(4): 451–9, 1976.
2. ——, Efficiency of chemical ripener action in sugarcane. V. Superior efficiency of CP 70139 (Monsanto) in direct comparisons with Polaris, J. Agric. Univ. P.R. 61(2): 160–9, 1977.

3. ——, and Montalvo-Zapata, R., Evaluation of chemical ripeners for sugarcane having constant nitrogen and water regimes. I. Growth, quality and enzymic responses to nine potential ripeners, Trop. Agric. Trinidad, 49: 35–44, 1973.
4. Ramírez-Silva, F. J. and Rivera-Brenes, A., Establecimiento de un método directo de las cañas entregadas para molienda mediante el uso de cala mecánica (core sampler) y para el cálculo de rendimiento de las entregadas a las centrales Fajardo y Cambalanche, Sección VII A-B, Informe Junta Azucarera de P.R. 15 de julio de 1970.
5. Samuels, G., Foliar Diagnosis for Sugarcane, Agricultural Research Publications, p. 59, Río Piedras, P.R. 1969.
6. ——, and Vélez-Ramos, A., Field experiments with Polaris as a chemical ripener of sugarcane in Puerto Rico 1971–72, J. Agric. Univ. P. R. 61(2): 242–9, 1977.