Effect of Individual Leaf-Trimming on Flowering in Sugarcane[1]

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INTRODUCTION

It is commonly accepted that leaves are the principal sites of photoinduction in flowering plants, although the stem, terminal buds, and roots may also participate to some degree. Working with sugarcane, Coleman (3) observed that leaf and leaf-spindle tissue appear to have separate roles in floral induction. Studies by Julien (4) showed that the removal of mature leaves (+3 and +4) hastened flowering, while removal of leaf +1, leaf +2, or the spindle delayed flowering in the variety U.S. 48-34; and he proposed that the lower leaves produce a transmissible inhibitor which prevents growth of the flower primordia.

Work in Puerto Rico by Chu and Serapion (2) showed that the absence of the leaf spindle at any time during the differentiation period substantially or completely prevented flowering by each of the three cane varieties studied. Leaves other than those of the leaf spindle appeared to play a less important role in flowering.

The investigations reported herein were designed to determine the relative importance of individual cane leaves in producing a flowering stimulus.

MATERIALS AND METHODS

Two-eye cuttings of the varieties N.Co. 310 and P.R. 980 were planted in the field during early January 1970. A randomized block design with five replicates was adopted. About 2 months thereafter all plants were fertilized with 500 pounds per acre of a 14-4-10 fertilizer. Three irrigations were applied during the germination and the plant's tillering stage.

A series of eight leaf-trimming treatments were established on the basis of variable leaf ranks and leaf-removal dates. As summarized in the following tabulation, leaves −2, −1, and 0 were removed once, on September 1, and leaves +1 to +4 were removed twice, on August 14 and 31, 1970:

[1] Manuscript submitted to the Editorial Board December 27, 1971.

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The authors wish to express appreciation to Dr. A. J. Alexander, Phytophysiologist, Department of Agronomy and Soils, Agricultural Experiment Station, University of Puerto Rico for suggestions in the preparation of this manuscript.

Treatment (leaf rank removed)[3]	*Number of trimming*	*Date of removal*
−2[4]	1	September 1, 1970
−1	1	Do.
0	1	Do.
+1	2	August 14 and 31, 1970
+2	2	Do.
+3	2	Do.
+4	2	Do.
Control	None	None

Twenty plants from each variety were employed in each treatment. No leaves were removed from control plants. Tassel counts were made at 5-day intervals beginning when the first emerging inflorescence became visible. Stalks failing to produce a tassel were dissected in early February 1971, and the flowering status was recorded. The percentages for floral initiation and emerged tassels were calculated and subsequently transformed into angles for a statistical analysis in accordance with Snedecor (7).

RESULTS

Flowering responses to individual leaf-trimming are presented in tables 1 and 2, and figures 1 and 2. Treatment effects were measured in relation to floral initiation, partial induction followed by reversion to the vegetative state, abortive inflorescence, and emerged tassel. As shown in table 1, the removal of leaf 0, on September 1, +1, or +2, on August 14 and 31, resulted in markedly higher initiation intensity in the variety N.Co. 310. This effect was significant at the 5-percent level. In contrast, the absence of leaf −1, removed once on September 1, reduced flower initiation, although the response was not statistically significant. The lack of influence on flowering was noticed when leaves −2, +3, or +4 were removed. Somewhat similar responses were obtained with reference to tassel emergence. Tassel emergence was highest following the removal of leaf +1 on August 14 and 31 (fig. 1). This response was significant at the 1-percent level.

The variety P.R. 980 (table 2) showed similar floral initiative responses but of lesser magnitude than N.Co. 310. None of the changes were statistically significant. Tassel emergence was significantly reduced in P.R. 980 by the removal of leaf −2 once on September 1 (fig. 2).

[3] The leaf having the highest visible dewlap was designated as leaf +1. The older and younger leaves were consecutively numbered as leaf +2, +3, and 0, −1, respectively.

[4] Including all the younger leaves rolled within leaf −2.

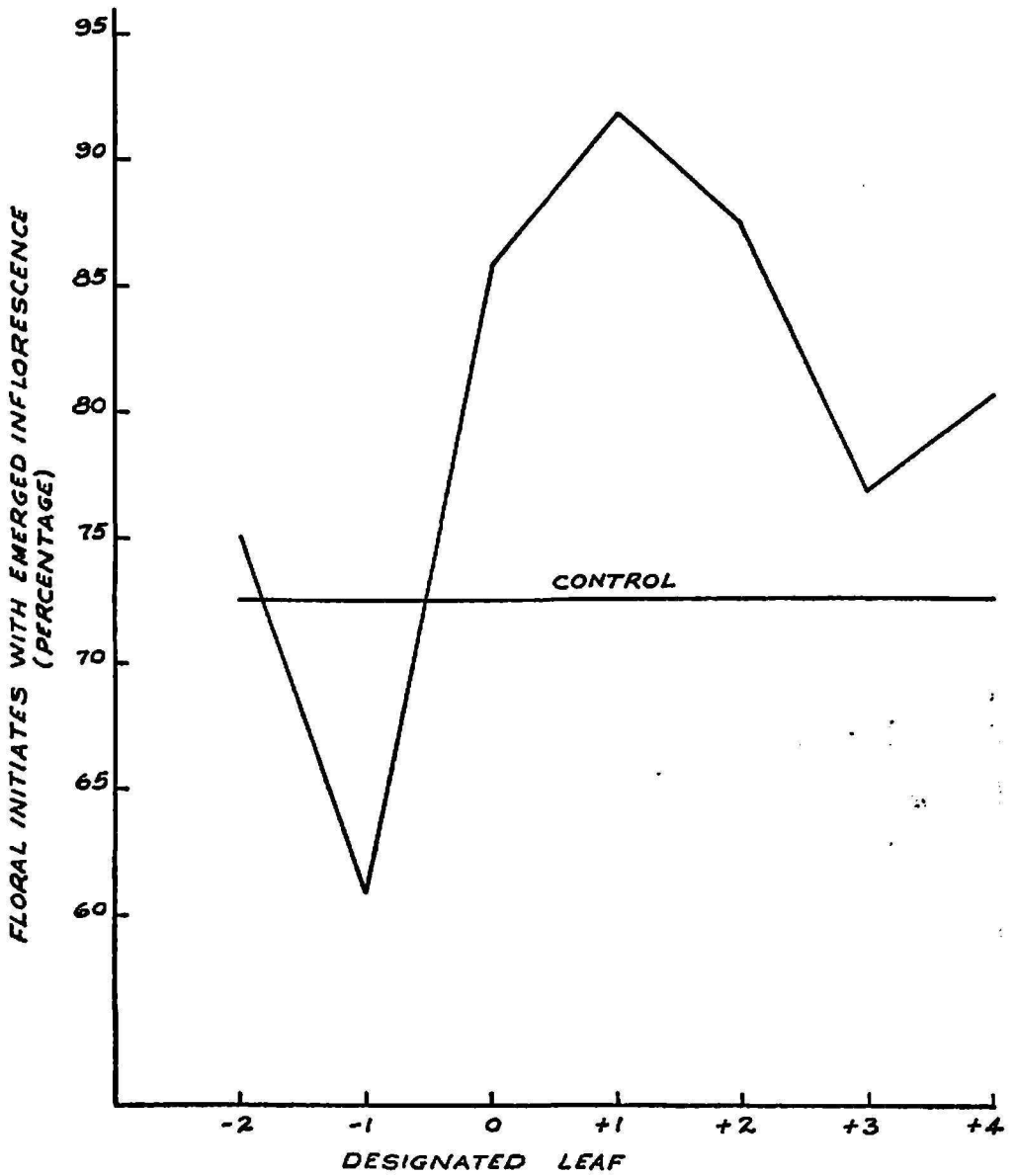

FIG. 1.—Effect of trimming the individual leaf on the percentage of emerged inflorescence in the variety N.Co. 310 in 1970.

DISCUSSION

The present results are consistent with earlier findings (2) showing the spindle leaf to play a much more important role than other leaves in the production of a flowering stimulus.

From figures 1 and 2 it is evident that leaves 0, +1 and +2 in N.Co. 310 are most effective in reducing flowering of this variety. The majority of leaves designated as 0 in P.R. 980 and −1 in N.Co. 310 were fully or partially expanded when removed. This agrees with the work of Khudairi et al. (5) who found that young expanding leaves most effectively produced the flowering stimulus in *Xanthium*. The completely furled leaf seems to

be too young physiologically to contribute toward flowering stimulus production. This was demonstrated by the fact that no effects on flowering were produced by removing leaf −2 for N.Co. 310 (fig. 1) and leaf −1 for P.R. 980 (fig. 2).

The increased intensity of floral initiation and tassel emergence in N.Co. 310 resulting from the loss of leaf 0, +1, or +2 (fig. 1) is best interpreted

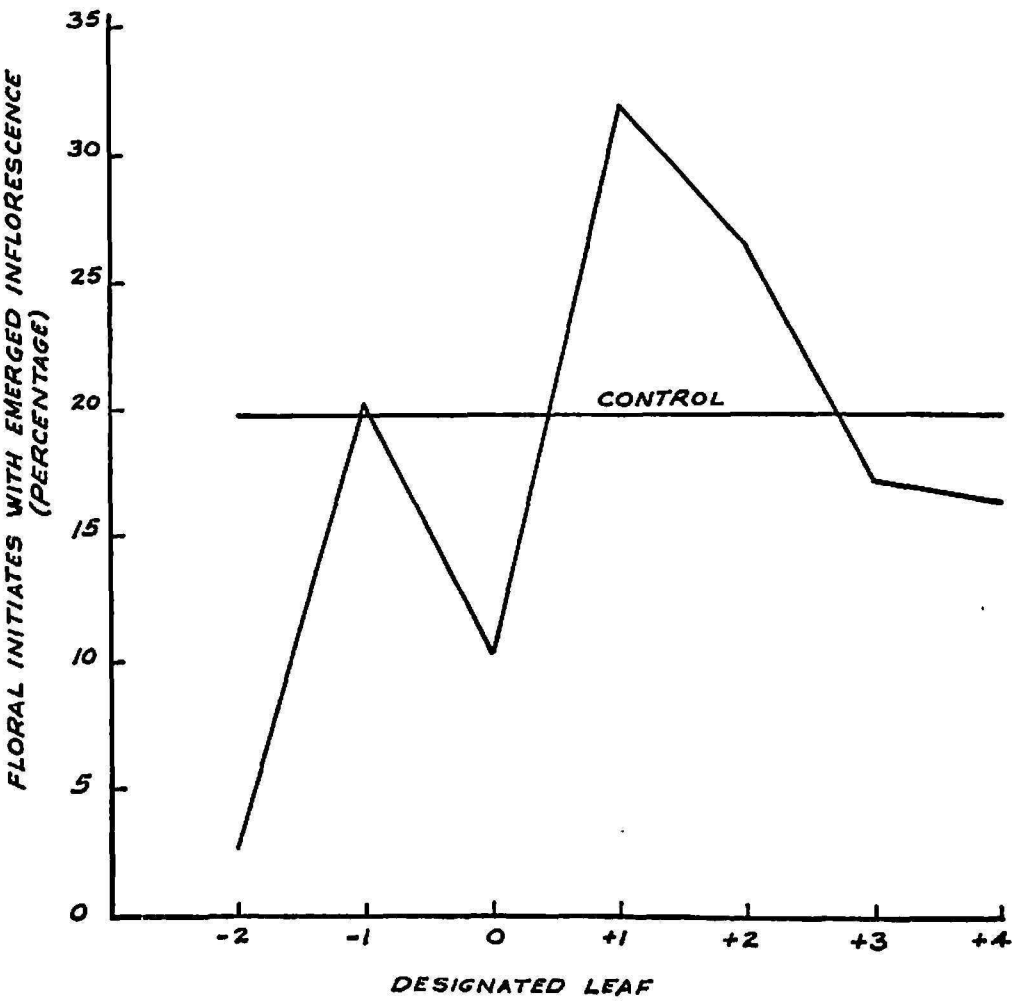

FIG. 2.—Effect of trimming the individual leaf on the percentage of emerged inflorescence in the variety P.R. 980 in 1970.

by assuming that these leaves produce a transmissible flowering inhibitor. Such an inhibitor might reduce the accumulation or fixation of a flowering stimulus. It is also possible that these leaves ordinarily produce a flow of assimilates sufficiently large to dilute the flowering stimulus or prevent its reaching the apex (6).

In view of the response to individual leaf-trimming in N.Co. 310, the photoinductive sensitivity of sugarcane leaves appears to be gradually diminishing with increasing age.

TABLE 1.—*Effect of individual leaf-trimming on floral initiation and tassel emergence in the variety N.Co. 310 in 1970*

Treatment (leaf rank removed)	Total number stalks treated	Total number stalks initiated	Percent initiation	Transformed angle for percent initiation	Total number tassel emergence	Percent tassel emergence	Transformed angle for percent tassel emergence
			Average	*Average*		*Average*	*Average*
−2	234	180	78.9	63.92	171	75.2	61.21
−1	218	137	62.1	52.22	134	60.9	51.42
0	219	200	91.3	73.68*	188	85.9	68.80
+1	266	246	92.6	75.23*	244	91.8	74.58**
+2	254	229	90.6	72.75*	220	87.3	65.98
+3	253	208	80.3	64.48	200	76.8	61.92
+4	231	189	82.3	67.73	185	80.5	65.77
Control	249	189	74.9	60.29	183	72.6	58.68
			LSD P 5% = 11.38[5] 1% = 15.36			LSD P 5% = 11.01[5] 1% = 14.85	

[5] Test of significance of the difference between each treatment and control.

TABLE 2.—*Effect of individual leaf-trimming on floral initiation and tassel emergence in the variety P.R. 980 in 1970*

Treatment (leaf rank removed)	Total number stalks treated	Total number stalks initiated	Percent initiation	Transformed angle for percent initiation	Total number tassel emergence	Percent tassel emergence	Transformed angle for percent tassel emergence
			Average	*Average*		*Average*	*Average*
−2	170	40	20.9	25.93	8	2.7	8.21*
−1	199	101	49.0	44.33	41	20.2	26.36
0	191	55	30.1	35.93	18	10.2	15.93
+1	220	120	55.7	48.46	66	31.9	33.82
+2	167	74	45.7	42.12	42	26.3	26.08
+3	179	64	36.1	36.74	30	17.1	23.33
+4	188	63	33.5	35.22	29	16.2	23.32
Control	187	68	34.8	35.22	38	19.7	25.40
			LSD P 5% = 15.43[6] 1% = 20.82			LSD P 5% = 14.06[6] 1% = 18.97	

[6] Test of significance of the difference between each treatment and control.

SUMMARY

The effect of individual leaf-trimming on sugarcane flowering is reported herein. Two varieties, N.Co. 310 and P.R. 980, were grown in the field under normal conditions of climate and nutrition. Individual leaf ranks were trimmed away twice (August 14 and 13) or once on September 1.

It was shown that the expanding leaf and the leaf just fully expanded probably were most effective in producing the flowering stimulus. Greatest activity was found in the leaf −1 for N.Co. 310 and leaf 0 for P.R. 980. A significant depression in tassel emergence caused by the removal of leaf −2 and all the younger leaves within it may be related to the absence of leaf 0 which failed to appear in the normal replacement sequence during the critical period for primordia differentiation in P.R. 980.

Both floral initiation and tassel emergence were increased by removing leaf 0, +1, or +2 in N.Co. 310. Selective defoliation was most effective when performed twice, on August 14 and 31. No significant effect on flowering was produced by removing an older leaf (+3 or +4), or a younger leaf (−1, P.R. 980, or −2, N.Co. 310), during the critical floral induction period.

RESUMEN

En este trabajo se informan los efectos producidos sobre la florecida de la caña de azúcar por la remoción de distintas hojas individuales.

Las variedades N.Co. 310 y P.R. 980 se sembraron en parcelas repetidas, cultivándose bajo condiciones normales de nutrición y clima.

Las hojas +1, +2, +3 ó +4 se recortaron en agosto 14 y agosto 31, y las 0, −1 ó −2 solo en septiembre 1. Se observó que las hojas a punto de abrir por completo y las recién abiertas fueron las que más efectivamente redujeron la florecida. La remoción de las hojas 0, +1 ó +2 en la N.Co. 310 produjo un aumento en la iniciación de la florecida y la de la hoja +1 en la emergencia de la panícula.

La defoliación selectiva fue más efectiva cuando se hizo dos veces, a saber, en agosto 14 y 31.

La eliminación de una hoja madura (la +3 ó la +4) o de una hoja nueva (la −2 en la N.Co. 310 ó la −1 en la P.R. 980) durante el período crítico de la inducción no afectó significativamente dicho proceso.

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