

Evaluation of the damage caused by leaf feeders in sugar cane through simulated defoliation

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Introduction

In the Cauca Valley, sugar cane fields may be attacked by several species of leaf feeding insects; however, the attacking species usually are dependent on the age of the crop. From germination up to 4 months of age, sugar cane may be infested by insects belonging to the genus *Spodoptera* or *Mocis* while at ripening the brassolid *Caligo ilioneus* has been very abundant. Plants are supposed to recover when damage occurs while they are young but losses can be important and control measures are necessary when it occurs late.

However, for the Cauca Valley conditions, there is no precise information about the intensity or duration of defoliation, or periods of development when the sugar cane is more susceptible to the reduction of photosynthetic area due to insect feeding. Most of the information available at present comes from research conducted to find out the importance of the locust as a sugar cane pest and was summarized by Bullen & McCuaig¹. According to field information, it has been established that in the Philippines a 14% reduction in the yield of cane occurs on average, but it can reach levels of 40% when 8 months-old canes are defoliated. In India, Singh & Singh² analysed the effect of artificial defoliation as a cultural practice to avoid lodging due to wind. They found out that, although the number of millable canes/ha increased after total defoliation, the tonnage was lower than with undefoliated canes. Burgos & Martorell³ reported that, in the Dominican Republic, 26,000 acres were damaged by *Calisto pulchella* (Lepidoptera: Satyridae) during 1972. A



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considerable loss of cane tonnage was observed and reductions up to 1% of available sucrose were detected.

In Colombia, Raigosa⁴ from Providencia Mill conducted a trial of artificial defoliation to measure the damage caused by *C. ilioneus*, but results were not clearly conclusive.

Materials and methods

This trial was conducted at the experiment station of CENICAÑA, located at 3°N latitude, 1000 metres above sea level and having an average temperature of 24°C. For a first stage, the variety Mex 5229 was chosen because of its short cycle of 12 months. Short cycle varieties were considered to be more susceptible to leaf feeding insects because they have a short recuperation time. Defoliation was practised by hand, leaving the midrib intact just as leaf feeding pests do, and was conducted during four growing periods: 0 - 3, 3 - 6, 6 - 9, and 9 - 12 months of age. Five levels of defoliation were established: slight (the apical fourth of all the leaf blades located in the top fourth of every stalk was removed), medium (removal of the apical half of the leaf blade, of the top half of the leaves), heavy (removal of the apical 3/4 of the leaf blade and top 3/4 of the

leaves), total and an undefoliated check. Short defoliation consisted of the one single pass while long defoliation consisted of 4 weekly passes to keep plants under every treatment for one month. Combinations of treatments were replicated 4 times using a split-split plot design where the main plots corresponded to the duration (short and long defoliation) the subplots corresponded to the duration (short and long defoliation) the subplots corresponded to the periods and the sub-subplots to the levels. The experimental unit was conformed by four 5-m rows, spaced 1.5 m apart, planting 10 buds/m and keeping all the conventional cultural practices. In all treatments, stalk population of the central rows and length and diameter of the stalks were recorded 8 weeks after the corresponding defoliation was practised. At harvest, population, length and diameter were recorded in a similar way, and 10 stalk samples were taken for laboratory analysis to measure Brix, fibre content, sucrose, purity and estimated recoverable sugar (ERS).

In a second stage, some modifications were conducted based on the results and observations made in the previous one: CP 72-356 was used, and the following treatments were discarded:

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¹ in "Pests of sugar cane" Eds. Williams *et al.* (Elsevier, Amsterdam), 1969, pp. 391 - 409.

² *Sugar Cane*, 1986, (6), 4 - 6.

³ *Proc. West Indies Sugar Tech.*, 1973, 272 - 277.

⁴ Personal communication.

Table I. Stalk population and height 8 weeks after defoliation during 0 - 3 and 3 - 6 month periods (Var: Mex 5229)

Level of defoliation	No. stalks/10 m		Height, cm,	
	0 - 3 months	3 - 6 months	0 - 3 months	3 - 6 months
Check	262.6 a ¹	190.2 a	57.4 a	131.7 a
Slight	253.6 a	176.8 a	50.2 ab	108.6 b
Medium	249.6 a	198.8 a	51.5 a	107.8 b
Heavy	246.4 a	188.2 a	44.1 b	97.1 b
Total	227.0 a	243.6 b	34.2 c	61.0 c

¹ Averages in a column followed by the same letter do not differ statistically (p = 0.05)

Table II. Stalk height and weight at harvest in relation to the period of defoliation (Var: Mex 5229)

Defoliation period, months	Height, cm	Cane weight /10 m, kg
9 - 12	205.2 a ¹	174.6 a
0 - 3	203.3 a	178.1 a
3 - 6	185.9 b	156.8 a
6 - 9	178.2 b	149.4 a

¹ Averages in a column followed by the same letter do not differ statistically (p = 0.05)

Table III. Effect of duration, stages of development and levels of defoliation, on some variables determining sugar production measured at harvest (Var: CP 72356)

	No. stalks /10 m	Height, cm	Diameter, mm	Fibre, %	Purity, %	ERS, %	kg cane /10 m	Estimated sugar weight ¹ /10 m, kg
Duration, weeks								
4	86.2 a ²	329.4 a	25.4 a	12.4 a	87.5 a	11.7 a	262.1 a	30.6 a
8	82.3 a	326.1 a	25.7 a	12.3 a	86.5 b	11.2 b	245.5 b	28.0 b
Period, months								
0 - 3	83.8 a	331.4 a	25.2 a	12.1 a	87.0 a	11.9 a	255.6 ab	30.6 a
3 - 6	82.0 a	320.4 b	25.3 a	12.7 a	86.1 a	11.1 b	245.7 b	27.2 b
6 - 9	87.0 a	331.4 a	26.3 b	12.3 a	87.9 a	11.2 b	259.9 a	27.6 a
Level of defoliation								
Check	86.2 a	341.7 a	25.6 a	12.9 a	88.0 a	12.0 a	282.6 a	34.1 a
Medium	85.3 a	335.8 a	25.8 a	12.3 b	88.1 a	11.9 a	267.1 a	31.8 a
Total	81.2 a	305.7 b	25.3 a	11.8 b	84.9 b	10.3 b	211.5 b	22.0 b

1 Estimated sugar weight: ERS × kg cane/10 m

2 Averages of each column followed by the same letter, are not statistically different (p = 0.05)

defoliation at maturation, and slight and severe levels of defoliation. In this case, 4 weeks of continuous defoliation was considered as the short duration treatment while 8 weeks of continuous defoliation was considered as the long duration. All measurements and the experimental design were conducted in the same way as in the first stage.

Results and discussion

Plants that were totally defoliated during the period from 3 to 6 months, revealed an increase of number of stalks/10 m, 8 weeks after the treatment (Table I), probably owing to the fact that more light could reach the basal part of the stool, stimulating thereby the development of young stalks. A similar observation was reported by Singh & Singh². These stalks however, were of a reduced size. In plots defoliated severely for extended periods of time weeds could proliferate freely.

At harvest, an area of lower fertility was detected in the field that affected the experimental error in such a way that stalk length was the only variable that could be observed to be affected by defoliation (Table II). It was concluded that if defoliation occurs in the first three months of development, plants have enough time to recover and if it occurs during maturation it does not

have any effect at all.

The trial with CP 72-356 was planted in another field to avoid lodging and differences in fertility observed in the case of Mex 5229 and in the hope of reducing the experimental error. Once again, a reduction of the height and diameter of the stalks was observed 8 weeks after defoliation as well as an increase of the stalk population during the first 2 periods proportional to the degree of defoliation; however, at harvest no effect of duration, development period or degree of defoliation on the number of stalks/10 m could be detected (Table III).

Stalk height decreased as a result of the loss of foliage in the period from 3 to 6 months of age, and in general when the plants suffered total defoliation (Table III). The analysis of variance revealed a significant interaction between the levels of defoliation and the period in which it took place. Stalk height was particularly reduced by total defoliation during the period 3 - 6 months followed by the period 6 - 9 months (Figure 1), but a recovery occurred in plants defoliated along the period 0 - 3 months.

It was observed that purity, ERS, weight of cane and estimated sugar weight/10 m corresponding to short

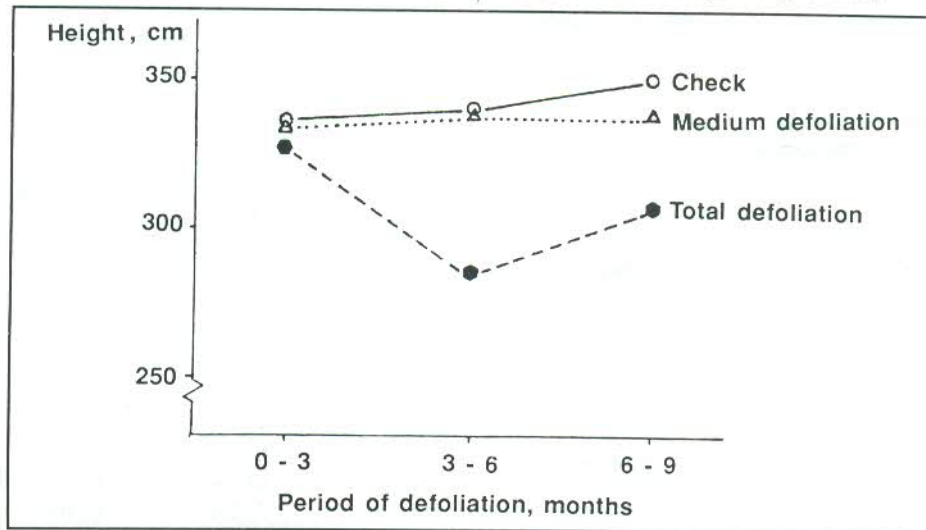


Fig. 1. Effect of defoliation on stalk height

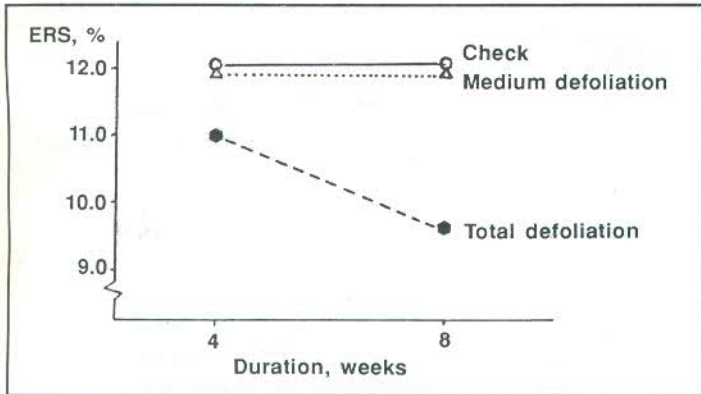


Fig. 2. Effect of defoliation on ERS, duration vs. levels of defoliation

duration treatment were greater than the corresponding values for long duration treatment (Table III). Cane defoliated at 3 - 6 months was the most susceptible, considering the variables ERS, weight of cane, and estimated sugar/10 m (Table III); it was also found that total defoliation had a detrimental effect while the moderate defoliation did not have an influence on these variables. An analysis of variance showed significant interactions for ERS, weight of cane and estimated sugar weight/10 m, between the duration and the levels of defoliation, as well as between levels and the period in which they occurred. The ERS was affected by total defoliation to a greater extent for the longest duration of defoliation. The ERS for moderate defoliation did not differ from that of the checks for both durations (Figure 2). Total defoliation during the periods 3 - 6 and 6 - 9 months had a similar effect on ERS but were different from those of other treatments (Figure 3).

The production variables, weight of cane and sugar/10 m, had similar responses to the loss of foliage. Total defoliation during 8 weeks had the most drastic effects over these variables (Figures 4 and 5); moderate defoliation did not affect the plants, nor cane and sugar production. When analysing the influence of the stage of development or period in relation to the levels of defoliation, a reduction of the weight of cane/10 m for total defoliation was observed (Figure 6). The effect on the estimated sugar production (Figure 7), was greatest during the 3 - 6 month period and minimum for the 0 - 3 month period, probably because of the effect of its component ERS pointed out previously.

In general, the results obtained in the first trial stage were confirmed more precisely in the second. This might be associated with having used different fields in the two stages, or different varieties (as mentioned by Bullen & McCuaig¹) or with the effect of longer

durations of defoliation. It is important to point out that some combination of the considered variables might appear exaggerated, but it has been already observed in the Cauca Valley that inadequate management of the pest may end in extreme cases, mainly because of a high population of the pest resulting from overlapping generations.

The observed effect of defoliation in the Cauca Valley was at first to stimulate stalk production and to reduce stalk size and consequently tonnage of cane and sugar. However, under our local conditions there is a better recovery of plants since the reductions in production were smaller than the ones reported in Africa using less drastic defoliation levels.

Conclusions

This trial proved that leaf feeding insects cause economic losses in sugar production particularly when they defoliate severely for extended periods

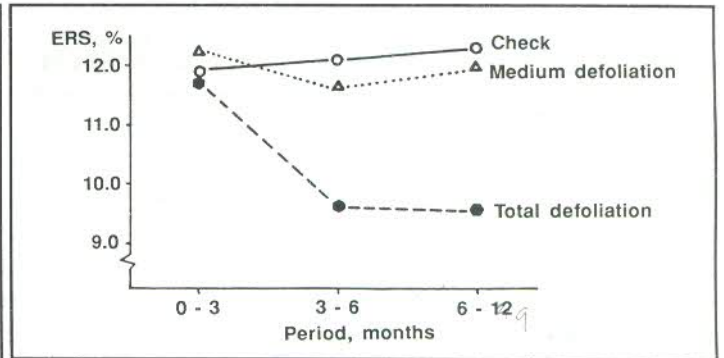


Fig. 3. Effect of defoliation on ERS, period vs. levels of defoliation

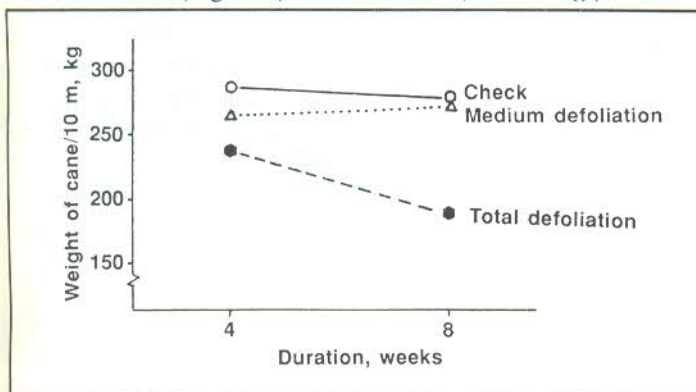


Fig. 4. Effect of defoliation on cane weight, duration vs. levels of defoliation

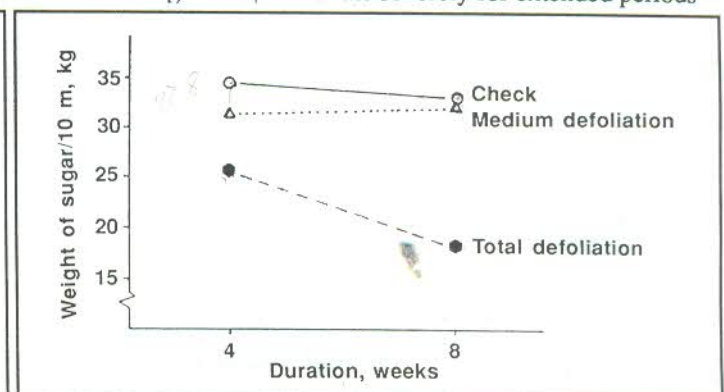


Fig. 5. Effect of defoliation on sugar production, duration vs. levels of defoliation

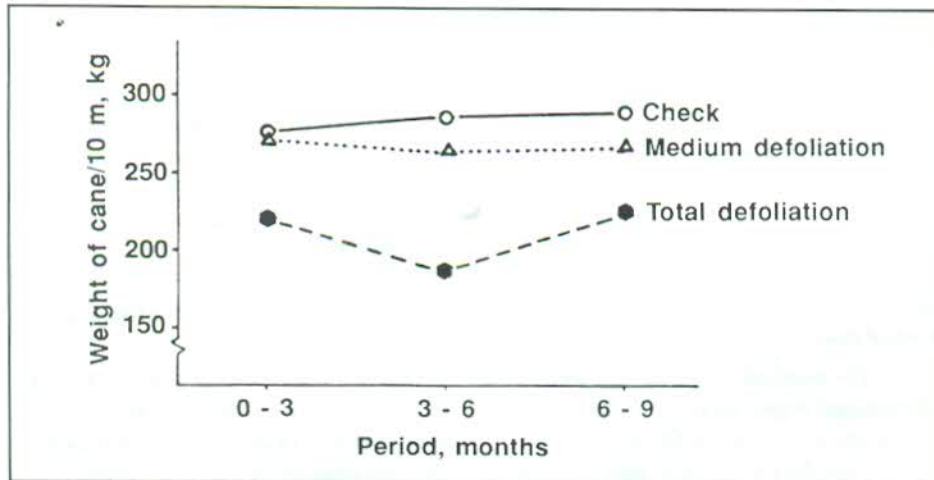


Fig. 6. Effect of defoliation on cane weight, period vs. levels of defoliation

short cycle varieties such as CP 72356, at ages varying from 3 to 9 months. Although length and stalk diameter of canes defoliated during a three-month period after germination, are notoriously reduced, they recover totally at harvest and therefore there is no reduction in the tonnage of cane and sugar production.

Summary

Damage caused by leaf feeders in sugar cane was measured using different levels and two durations of artificial defoliation during four growing periods

using plants of the varieties Mex 5229 and CP 72356. Stalk length was the only variable at harvest that respond to severe and total defoliation when carried out from the 3rd to the 9th month in Mex 5229. In CP 72356, stalk length was reduced but not its population and diameter. Cane tonnage was affected by defoliation when it occurred from the 3rd to the 6th month of cane growth. Sugar content decreased in plants defoliated for 6 months starting at the age of 3 months.

Evaluación del daño causado por

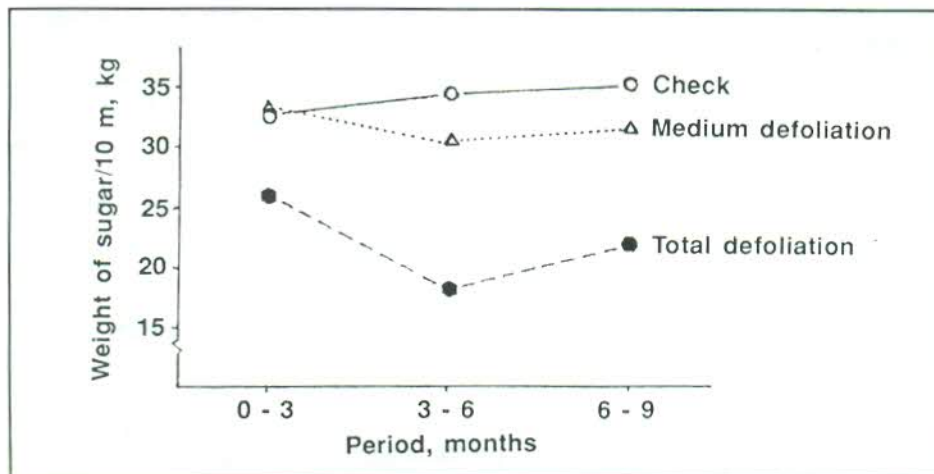


Fig. 7. Effect of defoliation on sugar production, period vs. levels of defoliation

comedores de follaje de caña de azúcar a través de la defoliación simulada

El daño producido por comedores de follaje de caña de azúcar se midió mediante diferentes niveles artificiales de defoliación con dos duraciones de ésta, y durante cuatro períodos de crecimiento, empleando plantas de las variedades Mex 5229 y CP 72356. A la cosecha, la longitud del tallo fue la única variable que respondió a las defoliaciones severa y total, cuando se realizó entre el tercero y noveno mes en Mex 5229. En CP 72356, la longitud del tallo se redujo pero no su población y diámetro. El tonelaje de la caña fue afectado por la defoliación cuando ésta ocurrió entre el tercero y sexto mes de crecimiento de la caña. El contenido de azúcar disminuyó en las plantas defoliadas durante seis meses, empezando a la edad de 3 meses.

Evaluation, par défoliation simulée, des dommages causés par les mangeurs des feuilles dans la canne à sucre

Les dommages causés dans la canne à sucre par les mangeurs des feuilles mesurés en utilisant différents niveaux et deux durées de défoliation artificielle pendant quatre periods de croissance, tout en utilisant des plantes des variétés Mex 5229 et CP 72356. Au moment de la récolte, la longueur de tige fut la seule variable qui répondait à une défoliation sévère et totale lorsqu'on l'appliquait entre le 3me et le 9me mois dans Mex 5229. Dans le cas de CP 72356, la longueur de tige fut réduite sans que la population ou le diamètre se modifiaient. Le tonnage en canne fut affecté [ar la défoliation lorsqu'on l'appliquait entre le 3me et le 6me mois de la croissance de la canne. La teneur en sucre diminuait dans les plantes défoliées pendant 6 mois avec début à l'âge de 3 mois.