EFFECT OF INSECTICIDES APPLIED AT SUGARCANE PLANTING ON *SPHENOPHORUS LEVIS* VAURIE (COLEOPTERA; CURCULIONIDAE) CONTROL AND ON THE YIELD OF FIRST TWO HARVESTS

By

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KEYWORDS: Saccharum, *Sphenophorus levis*, Insect Pests, Chemical Control, Management.

Abstract

RECENTLY, the occurrence of sugarcane fields severely damaged by *Sphenophorus levis* Vaurie (Coleoptera; Curculionidae) has increased in the Central-South region, the main area where sugarcane is grown in Brazil. The pest management program includes mechanical destruction of infested ratoons, which often is not enough to maintain the populations below economic injury level. The use of insecticides is therefore necessary. The objective of the present work was to evaluate the effect of insecticides applied at sugarcane planting on the pest control and on the yield of the first two harvests. Three experiments were conducted as random block designs with six replicates. In addition to an untreated check, the following treatments were evaluated: carbofuran 2100 g/ha a.i., fipronil 200 g/ha a.i., carbofuran 2100 g/ha a.i. + fipronil 200 g/ha a.i., imidacloprid 960 g/ha a.i., thiamethoxam 375 g/ha a.i. and bifenthrin 250 g/ha a.i.. *S. levis* infestations and associated plant injury were evaluated by periodic samplings. Yield data were recorded for the first two harvests. No differences between the treatments and the untreated check in relation to pest population and injury were observed. However, the treatments with fipronil, imidacloprid and thiamethoxam were associated with significant yield increases for both harvests. Considering the two harvests, these increases reached 52.2 to 69.0 t/ha or 25% of yield, suggesting that these treatments can be useful in an integrated management program.

Introduction

Recently, the occurrence of sugarcane fields severely damaged by *Sphenophorus levis* Vaurie (Coleoptera; Curculionidae) has increased in the Central-South region, the main area where sugarcane is grown in Brazil (Dinardo-Miranda, 2000). Damage is caused by the larvae that bore into the stool and, sometimes, the first basal internode, where they open large cavities (Precetti and Arrigoni, 1990). As a result of stool destruction the plants are stunted; the shoots become dry and die. The stand, the yield and the longevity of the crop are drastically reduced (Dinardo-Miranda, 2008).

The management of infested areas involves the mechanical destruction of infested ratoons, killing larvae and pupae of the pest, as well as the use of insecticides at planting.

Despite the importance of *S. levis* to sugarcane in Brazil, few studies on the efficiency of insecticidal control have been conducted. The objective of this study was to evaluate the effect of insecticides on *S. levis* control and on the yield at the first two harvests.

Materials and methods

Three experiments were conducted in São Paulo State, Brazil. Experiments 1 and 2 were planted on 15 February 2005 and 28 March 2005, respectively, with the sugarcane variety SP81-3250. Experiment 3 was planted on 11 May 2005 with RB867515. Plots consisted of six 10-m-long furrows, spaced at 1.50 m, distributed in a random block design with six replicates.

In experiment 1, treatments were: a) untreated check, b) carbofuran 2100 g/ha a.i., c) fipronil 200 g/ha a.i., d) carbofuran 2100 g/ha a.i.,+ fipronil 200 g/ha a.i., e) imidacloprid 960 g/ha a.i., f) thiamethoxam 375 g/ha a.i. and g) bifenthrin 250 g/ha a.i. The same treatments were tested in experiment 2 (except treatment d) and experiment 3 (except treatment b). Treatments were applied in the furrows, before closing them.

S. levis infestations and injury were evaluated in plant cane plots 2, 4, 6 and 8 months after planting, except in experiment 3, where the last sampling was not conducted. For ratoon cane sampling, data were collected 3 and 5 months after the first harvest.

For all samplings, a hole (0.50 m long, 0.50 m wide, 0.30 m deep) was opened in the first furrow of each plot. Soil and plant material were observed carefully to determine *S. levis* abundance and the total and injured shoots were counted to obtain the percentage of injured shoots.

Yields were determined for the first two harvests: 13 May 2006 and 26 May 2007 for experiment 1; 10 July 2006 and 4 Decmber 2007 for experiment 2; and 22 May 2006 and 22 May 2007 for experiment 3, by cutting and weighing the stalks from the second to sixth rows in each plot. The first row was not used to obtain the yield because many plants were destroyed during the sampling.

Prior to statistical analyses, *S. levis* population data were transformed to square root (x + 1) and injury data to arcsine (square root [x/100]). Each sampling date was analysed separately.

The analysis of variance was performed using SAS Statistical Analysis Systems software package (SAS Institute, 1995) and the treatment means were compared to untreated check means by Dunnett´s test. The experiment group analysis was also conducted using SAS software package, considering three experiments and seven treatments.

Results and discussion

The highest infestations and injury were observed in ratoons (Table 1). The destruction of infested crop residues and tillage prior to planting contributed to pest population reduction, due to mechanical damages and exposure to the sun and natural enemies of the larvae and pupae (Pizzano *et al.*, 1987). After planting, soil disturbance is minimised, allowing *S. levis* populations to increase.

Table 1—*Sphenophorus levis* infestation (SI , insects/hole) and percentage of damaged shoots (D, %), as a function of treatments and crop age (means of three experiments).

Treatment	Plant cane								Ratoon			
	2 months		4 months		6 months		8 months		3 months		5 months	
	SI	D	SI	D	SI	D	SI	D	SI	D	SI	D
Untreated check	0.1	0	0.1	0	0.3	1	0.2	4	1.0	21	1.1	37
Carbofuran	0	0	0	0	0.4	3	0.8	5	1.9	28	1.0	34
Fipronil	0	0	0.1	0	0.1	1	0.1	1	0.2	10	1.3	27
Carbofuran + Fipronil	0	0	0	0	0	0	0.2	1	1.0	18	0.8	35
Imidacloprid	0	0	0	0	0.3	3	0.4	3	1.7	29	1.5	44
Thiamethoxam	0	0	0	0	0.3	3	0.7	5	0.8	25	1.1	45
Bifenthrin	0	0	0.1	3*	0.4	2	0.6	4	1.0	18	0.9	45
F value	1.00		1.18	1.92	1.05	1.50	1.96	1.89	3.45	3.13	0.73	0.71
P value	0.44		0.33	0.09	0.40	0.19	0,09	0.10	0.01	0.01	0.62	0.63
C.V. (%)	6.8		9.6	10.2	25.6	30.5	21.7	38.6	30.0	25.0	29.9	26.1

Means within columns marked with (*) differ from untreated check (Dunnett´s test, P < 0.10).

No differences in *S. levis* infestations and injury were observed between insecticide treated and untreated check plots, except four months after planting, when the bifenthrin treatment presented a higher percentage of shoot damaged than the check (Table 1).

For the plant cane harvest, all insecticide treatments were associated with increased yields. For the second harvest, fipronil, fipronil + carbofuran, imidacloprid and thiamethoxam plots had greater yields than untreated check plots (Table 2).

Carbofuran seems not as effective as fipronil, imidacloprid or thiamethoxam because, in plant cane, this product showed the smallest yield increase, while, in the ratoon cane, it did not contribute to increase the yield.

Since plots treated with fipronil showed the same level of increase as the plots treated with fipronil + carbofuran, it can be argued that effects on yield, in the ratoon cane, were due to fipronil.

Table 2—Yields (t/ha) observed at first and second harvest, as a function of treatments and total increase of yield of each treatment in relation to check (Δ) (means of three experiments).

Treatment	1st Harvest	2nd Harvest	1st+ 2nd Harvests	Δ
Untreated check	141.8	134.4	276.2	
Carbofuran	154.1*	139.4	295.5	17.3
Fipronil	166.2*	167.6*	333.8*	57.6
Carbofuran + fipronil	172.2*	173.0*	345.2*	69.0
Imidacloprid	170.8*	167.0*	337.8*	61.6
Thiamethoxam	172.0*	160.4*	332.4*	56.2
Bifenthrin	156.2*	145.7	301.9	25.7
F value	11.46	6.91	13.01	
P value	<0.0001	<0.0001	<0.0001	
C.V. (%)	8.2	7.3	5.9	

Means within columns marked with (*) differ from untreated check (Dunnett´s test, P < 0.10).

There was no evident correlation between pest population and yield, because no differences were observed among the treatments in relation to pest population. The sampling method may not have been precise enough to evaluate the pest population. It is evident that the insecticides were not very efficient, probably because they tend to move to the stalks and leaves, staying in low concentration in plant and ratoon stool, where *S. levis* larvae feed. Despite the fact the insecticides were not efficient in controlling *S. levis*, they increased yields.

Although some insecticides like thiamethoxam and imidacloprid contribute to yield increases ranging from 4 to 8 t/ha when applied in fields with low pest pressure, due to their direct effect on the plants, increases like those observed in these experiments can not be attributed to this effect.

Since others pests were not found in the experimental areas, the lower yields observed in untreated plots, compared with treated plots, can be attributed to *S. levis* populations. In fact, commercial areas infested with 0.5 *S. levis* per hole show clear symptoms of the pest attack, like stand and yield drastically reduced.

On average, treatments with fipronil, fipronil + carbofuran, imidacloprid and thiamethoxam applied at planting contributed to yield increases ranging from 56.2 to 69.0 t/ha for the first two harvests combined, suggesting that these insecticides can be useful in an integrated management program.

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APPLICATION DES INSECTICIDES À LA PLANTATION CONTRE LE *SPHENOPHORUS LEVIS* VAURIE (COLEOPTERA; CURCULIONIDAE) ET SUR EFFET SUR LE RENDEMENT DES DEUX PREMIÈRES RÉCOLTES DE LA CANNE À SUCRE

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MOTS CLÉS: Saccharum, *Sphenophorus levis*, Ravageurs, Lutte Chimique, Gestion des Ravageurs.

Résumé

RECEMMENT, la fréquence des champs de canne à sucre sévèrement endommagés par le *Sphenophorus levis* Vaurie (Coleoptera; Curculionidae) a augmenté dans la région méridionale-sud, le partie la plus importante pour la culture de la canne au Brésil. Le programme de gestion du ravageur inclut la destruction mécanique des repousses infestées, qui souvent n'est pas suffisant pour maintenir la population en dessous du seuil de nuisibilité économique. Le recours aux insecticides est donc nécessaire. Le but de la présente étude est d'évaluer l'effet des insecticides appliqués à la plantation de la canne sur le ravageur et sur le rendement obtenu pendant les deux premières récoltes. Trois essais ont été entrepris en adoptant un dispositif de blocs randomisés avec six répétitions. En sus du témoin non-traité, les traitements suivants ont été évalués: carbofuran à 2100 g/ha m.a., fipronil à 200 g/ha m.a., carbofuran à 2100 g/ha m.a. + fipronil à 200 g/ha m.a., imidacloprid à 960 g/ha m.a., thiamethoxam à 375 g/ha m.a. and bifenthrin à 250 g/ha m.a. Les infestations de *S. levis* et les dégâts occasionnés ont été évalués grâce à un échantillonnage périodique. Les données de rendements pour les premières récoltes ont été recueillies. Aucune différence n'a été observée entre les parcelles traitées et celles non-traitées par rapport à l'infestation et les dégâts. Cependant, les traitements au fipronil, à l'imidacloprid et au thiamethoxam ont entraîné une augmentation significative du rendement pour les deux récoltes. Effectivement, les augmentations ont atteint 52.2 à 69.0 t/ha ou 25% de rendement, suggérant que ces traitements puissent être utiles dans un programme de lutte intégrée.

EFECTO DE LOS INSECTICIDAS APLICADOS DURANTE LA SIEMBRA EN EL CONTROL DE *SPHENOPHORUS LEVIS* VAURIE (COLEOPTERA: CURCULIONIDAE) Y EN LA PRODUCCIÓN DE CAÑA EN LOS DOS PRIMEROS CORTES

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PALABRAS CLAVE: *Saccharum*, *Sphenophorus levis*, Control de Plagas, Control Químico, Manejo.

Resumen

RECIENTEMENTE se ha observado el aumento de campos de caña de azúcar severamente afectados por Sphenophorus levis Vaurie (Coleoptera, Curculionidae) en la región Centro-Sur, principal área donde se cultiva caña de azúcar en el Brasil. El programa de manejo de la plaga incluye la destrucción mecánica de retoños infestados, lo que a menudo no es suficiente para mantener las poblaciones del insecto por debajo del nivel de daño económico, siendo necesario el uso de insecticidas. El objetivo del presente trabajo fue evaluar el efecto de los insecticidas aplicados durante la siembra de caña en el control de la plaga y determinar la producción de los dos primeros cortes. Se realizaron tres experimentos con diseños de bloques al azar y seis repeticiones. Además del control sin tratar, se evaluaron los siguientes tratamientos: Carbofuran, 2100 g/ha de ingrediente activo (i.a.), Fipronil, 200 g/ha de i.a., Carbofuran, 2100 g/ha de i.a.+ Fipronil, 200 g/ha de i.a., Imidacloprid, 960 g/ha de i.a., Tiametoxam, 375 g/ha de i.a. y bifentrina, 250 g/ha de i.a. Se evaluaron las infestaciones y daños asociados con S. levis mediante muestreos periódicos. Los resultados de producción se registraron durante los dos primeros cortes. No se observaron diferencias entre los tratamientos y el control sin tratar en relación con la población de la plaga y el daño causado. Sin embargo, los tratamientos con Fipronil, Imidacloprid y Tiametoxam se tuvieron aumentos significativos de producción de caña, en ambos cortes. Teniendo en cuenta los dos cortes, los aumentos fueron de 52.2 a 69.0 t/ha o aumento de 25% en la producción, lo que sugiere que estos tratamientos pueden tener utilidad en un programa de manejo integral.