EFFECTS OF INSECTICIDES ON *MIGDOLUS FRYANUS* WESTWOOD (COLEOPTERA: CERAMBYCIDAE) INFESTATIONS AND SUGARCANE YIELDS

By

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KEYWORDS: Saccharum, Insect Pests, Chemical Control.

Abstract

THE DESTRUCTION of root system by *Migdolus fryanus* Westwood (Coleoptera: Cerambycidae) larvae reduces the yield and the longevity of sugarcane crops. Because of this damage, this insect is one of the most important pests of sugarcane in São Paulo State, Brazil. The present study was conducted to evaluate insecticide efficacy, when applied: a) at a depth of 40 cm, using ploughshares, during the land preparation prior to planting; b) in the furrows, at planting; and c) both at 40 cm and in the furrows. The experiment was carried out at the Santa Rita Sugar Mill, São Paulo, Brazil, using a randomised complete block design with 16 treatments (insecticides applied in the furrow and/or at 40 cm, and an untreated check) and 4 replicates. Sugarcane was planted in plots with five 15 m rows spaced 1.40 m apart, in March 2007. The pest populations were evaluated in periodic samplings and, on November 2007, when there was a flight of adults in the experimental area. The highest yields were observed in plots treated with endosulfan or fipronil. The treatments applied at 40 cm were more effective than the application of insecticides in the furrows. Fipronil or endosulfan applied at 40 cm, with or without additional insecticides in the furrows, increased yields by more than 25% over the untreated check.

Introduction

Migdolus fryanus (Coleoptera: Cerambycidae) is one of the most important pests of sugarcane in São Paulo State, Brazil. The damage is caused by the larvae that attack both the roots and the stool, where they open large cavities.

As a result of roots and stools destruction, the plants are stunted, can be easily pulled out of the ground, and the stalks get dry and die. Thus, the crop stand, yield and longevity are drastically reduced (Dinardo-Miranda, 2008).

Current management strategies of infested areas involve several measures of control; however, none of them provide satisfactory control (Bento *et al*., 2004; Dinardo-Miranda, 2008). One of the most popular tactics is the mechanical destruction of infested ratoons, which kills *M. fryanus* larvae and pupae, due to mechanical damage and exposure to the sun and natural enemies (Arrigoni *et al*., 1986).

However, in many cases, mechanical destruction is not sufficient to reduce *M. fruanus* populations below the economic injury level and infested areas need insecticide treatment. The objective of this study was to evaluate the effects of insecticides, under two forms of application, on *M. fryanus* infestations and on sugarcane yields.

Materials and methods

An experiment was conducted in a sandy soil area, in São Paulo State, Brazil. Plots consisted of five 15-m-long furrows, spaced at 1.40 m, distributed in a random block design with four replicates.

Treatments are presented in Table 1. On 21 March 2007, the plots were demarcated in the experimental area and the insecticides were applied at a depth of 40 cm, in designated plots, with a spraying system placed behind the ploughshare discs. On 27 March 2007, the furrows were opened for each plot, respecting plot delimitations. After planting the variety RB867515, the insecticides were applied in the furrows, according to the treatments. Furrows were immediately closed after insecticide application.

Table 1—Insecticide treatments tested for *M. fryanus* control in sugarcane.

Treatment	Insecticide applied at a depth of 40 cm (g/ha a.i.)	Insecticide applied in the furrows (g/ha a.i.)
A (Check)		
B		Imidacloprid (1152)
C		Fipronil (400)
D		Endosulfan (4200)
E	Imidacloprid (960)	
F	Imidacloprid (960)	Imidacloprid (576)
G	Imidacloprid (960)	Fipronil (200)
H	Imidacloprid (960)	Endosulfan (2100)
I	Fipronil (320)	
J	Fipronil (320)	Imidacloprid (576)
K	Fipronil (320)	Fipronil (200)
L	Fipronil (320)	Endosulfan (2100)
M	Endosulfan (3500)	
N	Endosulfan (3500)	Imidacloprid (576)
O	Endosulfan (3500)	Fipronil (200)
P	Endosulfan (3500)	Endosulfan (2100)

M. fryanus infestations were estimated on 20 June, 30 July, 3 October 2007 and 27 July 2008. For all samplings, a hole (0.50 m long, 0.50 m wide, 0.30 m deep) was opened in the first row of each plot. Soil and plant material were observed carefully to visualise biological forms of the pest and its damages.

The experiment was harvested on 27 July 2008. Stalk productivity was obtained by cutting and weighing the stalks from the second to fifth rows in each plot. The first row was not used to obtain the cane yield because many plants were destroyed during the sampling.

Prior to statistical analyses, *M. fryanus* population data were transformed (square root [x + 1]). Each sampling date was analysed separately. The analysis of variance was performed using SAS Statistical Analysis Systems software package (SAS Institute, 1995) and all means were compared by Tukey´s test. To verify the interference of the form of application and the insecticides, the analysis was conducted as a factorial experiment, in which one of the factors corresponded to form of application (at a depth of 40 cm or in the furrows) and the other to four insecticide regimes (no insecticide, fipronil, imidacloprid, endosulfan).

Results and discussion

High larval populations were found only on the 27 July 2008 sampling date (Table 2). In November 2007, there was a flight of *M. fryanus* into the experimental area. Because the larvae can

live for 2 years in the deep soil layers, up to 5-m deep, and adults emerge 3 to 4 months prior to a flight (Arrigoni, 1988), it is possible to conclude that the *M. fryanus* larvae were present in the experimental area, during the three first samplings, but were not detected because of their deep location.

When considering treatments individually, differences in *M. fryanus* infestations were only observed during the July 2008 sampling. Treatments with fipronil applied at a depth of 40 cm (treatments I, J and L) produced more than the untreated control (Table 2), suggesting that the treatment with fipronil in depth is important to improve the yield. Insecticides applied only in the furrows (treatments B, C and D) did not contribute to improved productivity.

When considering the treatments applied at a depth of 40 cm, regardless of the treatment applied in the furrows, plots treated with fipronil or endosulfan produced more cane than the check (without insecticides at 40 cm) and the treatment with imidacloprid (Table 3). Since other pests were not observed in the experimental area, these data suggest that both insecticides applied at a depth of 40 cm reduced the *M. fryanus* population and consequently increased yields. No differences in pest infestations were observed among treatments, because the insects were living and eating the roots in the deeper layers of the soil.

Table 2—*Migdolus fryanus* populations as a function of sampling dates and yield

Treatment	*M. fryanus* (insects/hole)				Yield (t/ha)
	Jun 07	Jul 07	Oct 07	Jul 08	
A. Untreated check	0 a	0 a	0 a	3.5 ab	69.2 a
B. imidacloprid 1152 g/ha a.i in the furrows	0.3 a	0 a	0.3 a	4.0 ab	68.3 a
C. fipronil furrows 400 g/ha a.i in the furrows	0.3 a	0 a	0 a	3.0 ab	75.6 a
D. endosulfan furrows 4200 g/ha a.i in the furrows	0 a	0 a	0 a	1.8 ab	83.0 ab
E. imidacloprid 960 g/ha i.a. at 40 cm	0.3 a	0 a	0 a	7.0 a	69.0 a
F. imidacloprid 960 g/ha i.a. at 40 cm + imidacloprid 576 g/ha a.i in the furrows	0 a	0 a	0 a	4.0 ab	71.5 ab
G. imidacloprid 960 g/ha i.a. at 40 cm + fipronil 200 g/ha a.i in the furrows	0 a	0 a	0 a	3.0 ab	73.6 ab
H. imidacloprid 960 g/ha i.a. at 40 cm + endosulfan 2100 g/ha a.i in the furrows	0.3 a	0 a	0 a	4.3 ab	72.3 ab
I. fipronil 320 g/ha i.a. at 40 cm	0 a	0 a	0 a	2.0 ab	86.6 b
J. fipronil 320 g/ha i.a. at 40 cm + imidacloprid 576 g/ha a.i in the furrows	0 a	0 a	0 a	2.3 ab	86.0 b
K. fipronil 320 g/ha i.a. at 40 cm + fipronil 200 g/ha a.i in the furrows	0 a	0 a	0 a	3.8 ab	81.2 ab
L. fipronil 320 g/ha i.a. at 40 cm + endosulfan 2100 g/ha a.i in the furrows	0 a	0 a	0 a	2.8 ab	86.9 b
M. endosulfan 3500 g/ha i.a. at 40 cm	0 a	0 a	0 a	2.5 ab	81.2 ab
N. endosulfan 3500 g/ha i.a. at 40 cm + imidacloprid 576 g/ha a.i in the furrows	0.3 a	0.3 a	0 a	1.8 ab	82.8 ab
O. endosulfan 3500 g/ha i.a. at 40 cm + fipronil 200 g/ha a.i in the furrows	0 a	0.3 a	0 a	1.0 b	80.9 ab
P. endosulfan 3500 g/ha i.a. at 40 cm + endosulfan 2100 g/ha a.i in the furrows	0.3 a	0 a	0 a	1.0 b	81.6 ab
F value	0.67	1.11	0.45	2.11	4.58
P value	0.79	0.14	0.86	0.05	<0.001
CV (%)	12.1	7.6	10.1	30.7	8.3

Means followed by the same letters in columns are similar by Tukey´s test ($P < 0.05$).

Table 3—*Migdolus fryanus* populations at sampling dates and yield, as a function of the treatment made at a depth of 40 cm.

Treatment	*M. fryanus* (insects/hole)				Yield (t/ha)
	Jun 07	Jul 07	Oct 07	Jul 08	
Check (no insecticides at 40 cm)	0.1 a	0 a	0.1 a	3.1 ab	74.0 a
imidacloprid	0 a	0 a	0,3 a	4.6 a	71.6 a
fipronil	0.1 a	0 a	0 a	2.7 ab	85.1 b
endosulfan	0.1 a	0.1 a	0 a	1.6 b	81.6 b
F value	0.42	1.05	0.54	5.94	14.92
P value	0.89	0.16	0.86	0.05	<0.001
CV (%)	11.0	6.9	8.5	24.6	8.6

Means followed by the same letters in columns are similar by Tukey´s test (P < 0.05).

When considering treatments applied in the furrows, regardless of treatment applied at a depth of 40cm, no differences in pest populations and sugarcane yield were observed (Table 4). These observations suggest that, for the management of *M. fryanus* infested areas, fipronil or endosulfan applications into the soil profile are more effective than the applications in the furrows.

Table 4—*Migdolus fryanus* populations at sampling dates and yield, as a function of the treatment applied in the furrows.

Treatment	M. fryanus (insects/hole)				Yield (t/ha)
	Jun 07	Jul 07	Oct 07	Jul 08	
Check (no insecticides on the furrows)	0.1 a	0 a	0 a	3.8 a	76.5 a
Imidacloprid	0.1 a	0.1 a	0.1 a	3.0 a	77.2 a
Fipronil	0.1 a	0.1 a	0 a	2.7 a	77.8 a
Endosulfan	0.1 a	0 a	0 a	2.4 a	81.0 a
F value	0.27	1.94	0.54	1.42	2.02
P value	0.84	0.14	0.78	0.28	0.13
CV (%)	11.0	6.9	10.1	24.6	8.6

Means followed by the same letters in columns are similar by Tukey´s test (P < 0.05).

In conclusion, our data suggest that insecticide treatments applied at a depth of 40 cm were more effective than the application of insecticides in the planting furrows. Fipronil or endosulfan applied at this depth, with or without insecticides in the furrows, increased the yield by more than 25% over the untreated check.

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EFFETS DES TRAITEMENTS INSECTICIDES SUR L'INFESTATION DE *MIGDOLUS FRYANUS* WESTWOOD (COLEOPTERA: CERAMBYCIDAE) ET SUR LE RENDEMENT DE LA CANNE À SUCRE

Par

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MOTS CLÉS: Saccharum,
Ravageurs, Lutte Chimique.

Résumé

LA DESTRUCTION du système radiculaire par les larves de *Migdolus fryanus* Westwood (Coleoptera : Cerambycidae) occasionne une baisse de rendement et affecte la pérennité de la canne à sucre. En raison de ces dégâts, ce ravageur est un des plus importants de la canne à sucre dans l'État de São Paulo au Brésil. L'étude présente a été élaborée afin d'évaluer l'efficacité des insecticides appliqués a) à une profondeur de 40 cm en utilisant des socs, pendant la préparation du sol avant la plantation; b) dans les sillons à la plantation et c) par les deux méthodes à la fois. L'expérimentation a été effectuée à Santa Rita Sugar Mill, São Paulo au Brésil, en adoptant un dispositif de blocs complètement randomisés de 16 traitements (insecticides enfouis à 40 cm et/ou appliqués dans les sillons, et un témoin non-traité) avec 4 répétitions. En mars 2007, la canne a été plantée dans des parcelles de cinq lignes de 15 m et espacées de 1,40 m. La population du ravageur a été évaluée en faisant des échantillonnages périodiques dont en novembre 2007, lors des vols des adultes dans la parcelle expérimentale. Les rendements les plus élevés ont été obtenus dans les parcelles traitées à l'endosulfan ou au fipronil. L'application d'insecticide à 40 cm de profondeur a été plus efficace que le traitement dans les sillons. Le fipronil ou l'endosulfan enfoui à 40 cm, avec ou sans traitement additionnel d'insecticide dans les sillons, a augmenté des rendements par plus de 25% au-dessus du témoin non-traité.

EFECTOS DE INSECTICIDAS EN LAS INFESTACIONES DE *MIGDOLUS FRIANUS* WESTWOOD (COLEÓPTERA: CERAMBYCIDAE) Y EN LA PRODUCCIÓN DE CAÑA DE AZÚCAR

Por

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PALABRAS CLAVE: ***Saccharum*,**
Plagas de Insectos, Control Químico.

Resumen

LA DESTRUCCIÓN del sistema de raíces por las larvas de *Migdolus fryanus* Westwood (Coleoptera: Cerambycidae) disminuye la producción y longevidad de los cultivos de caña de azúcar. Debido a este daño, el insecto es una de las plagas más importantes de la caña de azúcar en el Estado de San Paulo, Brasil. El presente estudio se realizó para evaluar la eficacia de los insecticidas, cuando se aplican: a) a una profundidad de 40 cm, usando arados, durante la preparación de la tierra antes de sembrar; b) en los surcos, en la siembra, y c) tanto a 40 cm como en los surcos. El experimento se llevó a cabo en el Ingenio Santa Rita, San Paulo, Brasil, utilizando un diseño de bloques completos al azar con 16 tratamientos (insecticidas aplicados en el surco y/o 40 cm, y un control sin tratar) y cuatro repeticiones. La caña de azúcar se sembró en parcelas con cinco surcos de 15 m de largo, espaciados a 1.40 m, en marzo de 2007. Las poblaciones de la plaga se evaluaron en los muestreos periódicos y en noviembre de 2007, cuando hubo un vuelo de adultos en el área experimental. Las producciones más altas se observaron en las parcelas tratadas con Endosulfán o el Fipronil. Los tratamientos aplicados a 40 cm fueron más eficaces que las aplicaciones de insecticidas en los surcos. El Fipronil o el Endosulfán aplicado a 40 cm, con o sin insecticidas adicionales en los surcos, aumentó las producciones en más del 25% con respecto a la a los testigos sin tratar.