SCIENTIFIC NOTE

A Field Technique for Infesting Rice with *Elasmopalpus lignosellus* (Zeller) (Lepidoptera: Pyralidae) and Evaluating Insecticide Treatments

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Neotropical Entomology 32(2):367-371 (2002)

Técnica para Infestar Arroz com a Lagarta *Elasmopalpus lignosellus* (Zeller) (Lepidoptera: Pyralidae) no Campo e Avaliar Tratamentos com Inseticidas

RESUMO - Uma técnica para produzir lagartas *Elasmopalpus lignosellus* (Zeller), no laboratório, infestar plantas em campo e avaliar tratamentos foi descrita e testada em arroz. A ação de inseticidas para tratamento de sementes no controle da lagarta elasmo, utilizando infestação artificial e natural, também foi avaliada em experimentos de três datas de plantios. O delineamento experimental foi quadrado latino 6x6. A unidade experimental era formada de sete fileiras de arroz de 4 m de comprimento, espaçadas de 0,4 m. Os tratamentos consistiram dos seguintes inseticidas e doses: tiametoxam (52,5; 70 e 105 g i.a./100 kg sementes), furatiocarbe (320 g i.a./100kg sementes), carbofuram (525 g i.a./100 kg sementes) e testemunha não tratada. Infestações artificiais foram realizadas em dois grupos de três colmos, selecionados nas fileiras bordadura das parcelas e confinados em cilindros de PVC, em três datas de cada plantio. Colmos de cada cilindro foram infestados com três lagartas de *E. lignosellus* com sete dias de idade. Imediatamente após as infestações, os cilindros contendo três colmos de arroz foram protegidos do efeito das chuvas sobre as lagartas. Os danos foram avaliados 20 dias após as infestações. Infestações artificiais usadas neste estudo aumentaram o dano em 32 vezes, em relação à infestação natural das testemunhas. Inseticidas reduziram significativamente a sobrevivência de larvas até 60 dias após o plantio, comparados com a testemunha.

PALAVRAS-CHAVE: Insecta, elasmo, criação de insetos, tratamento de sementes

ABSTRACT - A technique for rearing *Elasmopalpus lignosellus* (Zeller),larvae in laboratory, infesting plants in the field and evaluating treatments was described and tested in rice. In addition, the performance of insecticides as seed treatments to control larvae, under artificial and natural infestations, was evaluated on three planting dates. The experimental design was a Latin 6x6 square and the experimental unit consisted of seven 4 m long rows and 0.4 m spacing between rows. Treatments consisted of the following insecticides and doses: thiamethoxam (52.5, 70, and 105 g a.i./100 kg seeds), furathiocarb (320 g a.i./100kg seeds), carbofuran (525 g a.i./100kg seeds), and an untreated control. Artificial infestations were made, in two groups of three selected tillers at the border rows in each plot and confined in PVC cylinders on three dates of each planting. Tillers were infested with three 7-day old *E. lignosellus* larvae. Immediately after infestation, cylinders containing three rice tillers were protected to avoid the effect of rain on the larvae. Damage was evaluated 20 days after the infestations. Artificial infestations increased the damage 32 fold, in relation to natural infestations in the untreated control. Insecticides reduced larval survival significantly for 60 days after planting compared to the untreated control.

KEY WORDS: Insect, lesser cornstalk borer insect rearing, seed dressing

The lesser cornstalk borer (LCB), *Elasmopalpus lignosellus* (Zeller), is an important pest of several crops. It attacks at least 60 species of plants (Stone 1968) and is a major pest of peanut, rice and corn (Berberet et al. 1979, Smith & Holloway 1979). Although this insect may damage flooded rice prior to water establishment, it is most important as a pest of upland rice. Severe attack often occurs in sandy soils and when rainfall is deficient. In these cases, areas over 100 ha can be devastated. (Ferreira & Martins 1984, Ferreira 1998). Because the attack of LCB has frequently resulted in economic damage in upland rice, preventive treatment with systemic insecticides has been recommended (Martins et al. 1980, Ferreira et al. 1994, Ferreira & Czepack 1997).

In view of the economic importance of LCB, studies to determine the susceptibility of rice varieties to this pest and the efficiency of recommended insecticides for its control are necessary. One limitation in conducting this kind of studies in the field is that natural infestations often are seldom suitable to distinguish levels of resistance or detect differences among insecticide treatments (Jenkins et al. 1982). Therefore, artificial infestation should be considered when chances for occurrence of natural populations are small (Wilson & Szaro 1988). Moreover, natural infestations are subject to weather changes and predation which are the major factors responsible for reducing the success of field experiments.

In this study, we describe a quick technique for infesting rice plants with LCB larvae in the field. In addition, we determined the performance of three insecticides as seed treatments to control LCB larvae, under natural infestations and under artificial infestation using the infestation technique.

Three field experiments were conducted during the summer of 1998 at Embrapa Arroz e Feijão near Santo Antônio de Goiás, GO. The variety Carajás was planted on November 6, November 26, and December 6, 1998. The experimental design was a Latin 6x6 square. The experimental unit consisted of seven, 4 m long rows with a spacing of 0.4 m between rows. Treatments consisted of the following insecticides and doses applied to the seeds: thiamethoxam (52.5, 70.0, and 105 g a.i./100 kg seeds), furathiocarb (320 g a.i./100kg seeds), and carbofuran (525 g a.i./100kg seeds). An untreated control was also included. Conventional tillage was used and post emergence weeds were eliminated by cultivation and by hand weeding.

Because the effect of a natural LCB infestation can be reduced by rain (Ferreira & Martins 1984), side plots were established and artificially infested using the following procedure to guarantee adequate damage for treatment comparisons. At the end of two internal border rows of each plot, on the diagonal, 24-26; 34-36, and 44-46 days after planting, two groups of three healthy tillers were confined in cylinders measuring 0.20 m in height and 0.25 m in diameter (Fig. 1). These cylinders were buried 5 cm deep in the soil to prevent the larvae escaping from the cylinders and to reduce the chance of being preyed on by ants and spiders, common predators in rice fields. Tillers were infested with three 7-day old cornstalk borer larvae per cylinder. The larvae used for infestations were obtained from a lesser cornstalk borer colony especially established from field collected adults for this study.

LCB adults commonly occur in Santo Antônio de Goiás during most of the year. To establish the LCB colony, female moths were collected in the field with a small sweep net, then transferred to a plastic 15 cm diameter and 15 cm long (400 cm^3) container, covered with a nylon screen and a sheet paper on top to be used as an oviposition site. Females prefer to lay eggs on blue paper with a slightly coarse texture (Chalfant 1975). A finer-textured paper is also acceptable. We found that the paper that comes with cotton rolls was preferred by the moth and the highest number of eggs could be collected. While in the cages, females were fed with a solution of beer, water and sugar in equal proportions, provided on moist cotton. Each cage held 30-40 moths and 300-400 eggs were obtained daily, for five days in the laboratory with no controlled environment condition. Larvae were maintained in 500 ml

Figure 1. Cylinder and rice tillers prepared for infestation.

plastic containers and fed with rice seedlings for seven days, then used for infestation in the field.

Immediately after infestation, each plot (cylinder containing three rice tillers) was covered with a transparent plastic bag (20 L capacity) to avoid the effect of rain on the larvae. The plastic bags were held by three 0.6 m long metallic shafts, inserted outside the cylinder (Fig. 2). One week after each infestation, the plastic bags were removed and the tillers marked with different colored plastic tags signifying the infestation dates. Then, the cylinders were removed to other sites for use in subsequent infestation.

The number of injured tillers was determined in naturally infested plots by examining tillers in two row-m of the three central rows of each plot at 15, 44, and 74 days after planting. Artificially infested plots were evaluated 20 days after each infestation to determine the number of tillers exhibiting symptoms of 'dead heart'. Artificial infestations with lesser cornstalk borer were made on all planting dates and compared with results from naturally infested plots.

The variables used to compare treatments were percentage of tillers with no symptoms of attack, number of panicles and yield. Percentage data was transformed using arc sin $\sqrt{P/100}$, and analyzed using the model for Latin square. Means were separated using the Dunnet test. The efficiency of insecticides for the variable percentage of non attacked tillers was determined using the Schneider & Orelli formula (Nakano et al. 1981) and the efficiency of the insecticides for the variables injured tillers and panicles using the Abbott (1925) formula.

Analysis of variance showed no significant interaction between any of the variables and planting dates ($P > 0.05$). Therefore, the data of the three experiments were combined and presented as a mean of the three experiments. Overall, plots naturally infested with LCB had only presented 0.6% of tillers with "dead heart" and artificially infested plots had 19.3% of tillers with "dead hearts". Artificial infestations, as used in this study, increased the proportion of damage 32 fold, compared to naturally infested (untreated control). In both natural and artificial infestations, the maximum number

Fig. 2. Cyllinder with rice plants and plastic bag covering after infestation

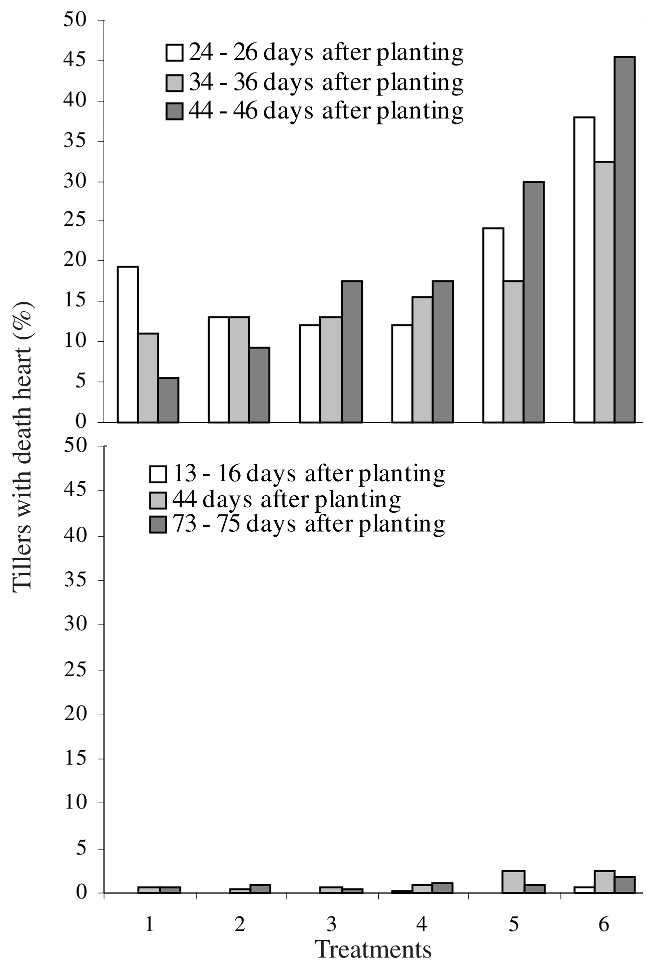

Fig. 3. Percentage of tillers exhibiting dead heart symptoms, in three planting dates. Santo Antônio de Goiás, GO. 1998. Superior: artificial infestations, Inferior: natural infestations. Treatments (insecticides and doses, g a.i./100 kg seeds): 1 = thiamethoxam 52.5; 2 = thiamethoxam 70.0; 3 = thiamethoxam 105.0; 4 = furathiocarb 320.0; 5 = carbofuran 525.0; 6 = control

of dead hearts was expressed at 44-46 days after planting. The treatment effects are shown in Fig. 3. In all infestations, a single larva per tiller was used. Even though one larva per tiller produced differences among treatments, larval mortality could be considerable even with the protection provided by covering the plots with a plastic bag as is evident from the coefficients of variation observed in the artificial infestation experiment (Table 1). It is possible to reduce variation among plots with common treatments, by either increasing plot size or the infestation ratio. Viana (1999) recommends two seven-day old larvae per corn plant in field experiments. Although this ratio is appropriate for corn plants, the ratio of one larvae/ tiller is more appropriate for rice.

The percentages of tillers showing no sign of *E. lignosellus* injury are summarized in Tables 1 and 2. The proportion of tillers with no sign of attack was significantly higher ($P < 0.05$) in tiamethoxam treated seed plots and furathiocarb treated plots than untreated control plots. Similar results were obtained in both artificially and naturally infested plots. The thiamethoxam seed treatment performed consistently better than carbofuram and furathiocarb on all three planting dates. However, none of them reached the 80% level, the minimum value required for recommendation.

Seed treatment in rice often improves plant stand by reducing plant mortality as indicated by the significantly higher number of undamaged tillers (Tables 1 and 2). However, seed treatment did not guarantee better yield. Even though the number of tillers and panicles was significantly higher in the seed treated plots than in the untreated control plots ($P < 0.05$), no significant differences in mass of spikelets or in yield (kg/ha) were observed between untreated control plots and those with insecticide treatments (Table 3), because that tiller mortality is compensated by the production of new tillers. Finally, it is important to mention that although seed treatment contributes to increase in plant stand and decrease in LCB damage during initial plant stages, it has no effect on root foraging termites during late plant stages.

One of the primary needs in breeding for insect resistance is a technique that allows a uniform and repeatable level of pest infestation (Jenkins et al. 1982). The technique we used for infesting rice plants with LCB larvae in the field can be used to provide insect pressure for the evaluation of a large number of treatments. This method can be easily adapted for screening breeding lines, eliminating the greenhouse effect on selecting varieties for insect resistance. The test can be quickly repeated even when weather conditions are not favorable for larvae survival. The exclusion of parasitoids and predators during and after infestation is essential.

Table 1. Percentages of tillers with no symptoms of *E. lignosellus* injury and efficiency of insecticides in experiment using artificial infestations. Santo Antônio de Goiás, GO, 1998.

Treatments	a. i./100 kg of seeds	Days after planting[1]			Efficiency (%)[2]
		24 -26	34 - 36	44 - 46	
Thiamethoxam	52,5	80.6* (25.1)	88.9* (12.8)[3]	94.4* (8.1)	67.4
Thiamethoxam	70,0	87.0* (14.6)	87.0* (12.2)	90.7* (11.7)	68.4
Thiamethoxam	105,0	88.0* (13.6)	87.0* (15.7)	82.4* (15.6)	63.2
Furathiocarb	320,0	88.0* (17.9)	84.3* (15.6)	82.4* (18.5)	60.4
Carbofuran	525,0	75.9 (26.3)	82.4* (15.6)	69.4* (19.2)	38.3
Control	0,0	62.0 (22.0)	67.6 (20.0)	54.6 (17.0)	-
Means	-	80.2	82.9	79.0	59.5
CV (%)	-	25.0	17.6	18.2	-

[1]Means followed by asterisks are significantly different from their corresponding control. Dunnet's test ($P < 0.05$).
[2]Schneider & Orelli's formula
[3]Values in brackets are the standard deviations

Table 2. Percentages of tillers, with no symptoms of *E. lignosellus* injury and efficiency of the insecticides using natural infestations. Santo Antônio de Goiás, GO. 1998.

Treatments	a.i (g)/100 kg of seeds	Days after planting			Efficiency (%)[1]
		13 - 16	44	73 -75	
Thiamethoxam	52.5	100.0 (0.2)[2]	99.3 (1.0)	99.3 (1.3)	67.3
Thiamethoxam	70.0	100.0 (0.2)	99.6 (0.5)	99.1 (1.1)	78.9
Thiamethoxam	105.0	99.9 (0.2)	99.3 (0.9)	99.5 (0.3)	70.8
Furathiocarb	320.0	99.8 (0.3)	99.2 (1.1)	98.9 (1.7)	47.8
Carbofuran	525.0	99.9 (0.1)	97.6 (3.4)	99.2 (0.7)	42.9
Control	0.0	99.6 (0.5)	97.5 (3.9)	98.1 (1.7)	-
Means	-	99.0	98.7	99.0	61.5
C.V (%)	-	0.3	2.0	1.2	-

[1]Schneider & Orelli's formula
[2]Values in brackets are the standard deviations

Tabela 3. Efficiency of insecticides and effect on yield. Combined results of all experiments. Santo Antônio de Goiás. GO. 1998.

Treatments	a.i. (g)/100 kg of seeds	Tillers / 2.4 m²		Efficiency (%)[1/]		Yield kg/ha
		Tillers	Panicles	Tillers	Panicles	
Thiamethoxam	52.5	446.2*	424.5*	44.8	50.6	1,554
Thiamethoxam	70.0	441.2*	418.4*	43.2	48.4	1,492
Thiamethoxam	105.0	448.9*	422.3*	45.7	49.8	1,691
Furathiocarb	320.0	430.4*	405.7*	39.7	43.9	1,605
Carbofuran	525.0	395.9*	378.1*	28.5	34.0	1,645
Control	0.0	308.1	281.9	-	-	1,557
Means	-	411.8	388.5	40.4	45.3	1,595
CV	-	13.4	14.8	-	-	18.0

Means followed by asterisks are significantly different from their corresponding control. Dunnet's test (P=0.05).
[1/]Abbott's formula

Acknowledgments

We thank Sr. Edmar Cardoso de Moura and Sr. Antônio Rodolfo de Resende for their help with the experiments. We also thank Dr. Anne S. Prabhu and Dr. Eliane D. Quintela, Embrapa Arroz e Feijão, for reviewing this manuscript.

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Received 13/07/01. Accepted 15/02/03.