CHEMICAL CONTROL OF *Oryzophagus oryzae* (COSTA LIMA, 1936) (COLEOPTERA: CURCULIONIDAE) ON FLOODED RICE BY SEED TREATMENT

CONTROLE QUÍMICO DE Oryzophagus oryzae (COSTA LIMA, 1936) (COLEOPTERA: CURCULIONIDAE) NA CULTURA DO ARROZ IRRIGADO ATRAVÉS DO TRATAMENTO DE SEMENTES

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ABSTRACT

*The effect of insecticides applied as seed treatment or granulated in the irrigation water, for the control of larvae of **Oryzophagus oryzae** (Costa Lima, 1936), was evaluated in a field experiment on flooded rice in conventional system at Embrapa Clima Temperado, Capão do Leão-RS, in the agricultural year 1999/2000. The insecticide thiamethoxam at the doses of 75, 100 and 125 g a.i. 100 kg^{-1} of seeds and fipronil at the doses of 25, 37.5, 50 and 62.5 g a.i. 100 kg^{-1} of seeds, when applied to the seeds of rice, reduced the larval population of **O. oryzae** significantly up to 40 days after flood irrigation, with control efficiency superior to 90%. However, rice seed treatment with thiamethoxam in the dose of 50 g a.i. 100 kg^{-1} of seeds controlled efficiently rice water weevil larvae only up to 25 days after irrigation. There were no significant differences among treatments in relation to rice yield. It is concluded that both insecticides in the evaluated doses have potential for use in irrigated rice crop for the control of larvae of **O. oryzae**.*

*Key words: Insecta, **Oryza sativa**, rice water weevil, preventive chemical control method.*

INTRODUCTION

The rice water weevil *Oryzophagus oryzae* (Costa Lima, 1936) (Coleoptera: Curculionidae) is one of the most harmful insects of irrigated rice crop in Brazil. Adults invade the crop during flood irrigation, feed on leaves and lay eggs in the submerged parts of the rice plant, but the main damage is caused by the larvae, found in the plants around the tenth day after the beginning of irrigation. Infestations, initially, concentrate on places with deeper water and can be spread to the whole area, even in parts without depressions in the land. According to estimates, yield losses caused by the rice water weevil oscillates around 10% and, several times, the damage to the plants is attributed erroneously to other problems like nitrogen deficiency, iron toxicity and salinity (MARTINS et al., 1997).

There are three causes for the expansion of the rice water weevil in Rio Grande do Sul State. The first is the replacement of old cultivars by modern ones, developed without considering resistance to the insect. The second cause is the increase of area with higher lands crops, mainly in the West frontier. This cultivation type, in inclined land, requires a larger number (and proximity) of walls and, therefore, there is a great number of plants growing on wall foots, where irrigation water is deeper and favorable to the development of the rice water weevil. The third cause of the expansion of the pest is the reduction in the use of insecticide seed treatment after the prohibition of the use of organochlorines.

Besides, with the increase in the last years, in Rio Grande do Sul, of rice area using the no tillage system (+ 250.000 ha), some farmers have verified higher incidence of pests in the initial phase of the culture, before flooding. As a hypothesis, the dead vegetable cover, essential for the success of the cultivation system, would be serving as shelter to phytophagous insects, mainly of underground habit, which damage seeds, roots and rice plantlets. The seed treatment with insecticides is seen as a promising method to reduce the current damage of such pests and, depending on the residual power of the used products, it could also reach the rice water weevil, on irrigated cultivation. According to MARTINS et al. (1997) seed treatments with insecticides carbossulfan TS, fipronil FS and imidacloprid have been highly efficient for the reduction of larvae population of *O. oryzae*, reaching control levels superior to 90%, similar to the obtained with carbofuran G applied directly to the irrigation water (PRANDO & PEGORARO, 1993; BOTTON et al., 1995). Recent studies show that thiamethoxam WS applied to rice seeds is effective against *O. oryzae*, with control levels superior to 85% (COSTA et al., 1999; GRÜTZMACHER et al., 1999).

The possibility for adoption of seed treatment is higher in areas with historical occurrence of soil pests in the period that precedes the flood irrigation. In those areas, the insecticides would control soil pests and provide better conditions for the plants, avoiding the need for high seed densities, usually used to compensate eventual losses of seeds or plantlets, consequently decreasing the production costs and, afterward, controlling *O. oryzae*.

The chemical control of *O. oryzae* is basically done in a curative, seeking to reach the larvae with a granulated formulation of carbofuran applied in the irrigation water. In spite of the high control efficiency of the insecticide, restrictions do exist to its use, mainly in relation to the high toxicity of the active ingredient and limitations due to the application practicability in the irrigation water.

In order to find more rational alternatives for the integrated control of *O. oryzae*, and to encounter new efficient alternative for pest control with low toxicity for superior animals, this research aimed to evaluate the effect of seed treatment on flooded rice in conventional system, with different doses of the insecticides thiamethoxam and fipronil for the control of the rice water weevil.

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MATERIALS AND METHODS

An experiment on flooded rice in conventional system was conducted in the experimental area of Embrapa Clima Temperado, in the county of Capão do Leão, RS, during the agricultural year of 1999/2000, being installed in the second fortnight of November of 1999 in a randomized blocks design, with ten treatments (Table 1) and four replications; experimental plots of 8 m^2 (ten rows of plants, each with 4 m of length, spaced 20 cm), surrounded by earth walls with individual entrance and exit of irrigation water to avoid contamination among treatments; early cultivar Embrapa 6-Chuí, sowed in the density of 120 viable seeds per linear meter. The seeds were treated three hours before sowing, according to methodology recommended by the makers. Ten days after the emergence, the population of plants was counted in a central row (4 linear m), in the treated plots and in the checks.

Table 1 - Treatments included in the experiment with insecticide seed treatment (g 100 kg^{-1} of seeds) or granulated insecticide applied in the irrigation water (g ha^{-1}) for control of *O. oryzae* larvae, on flooded rice. Embrapa Clima Temperado, Capão do Leão-RS, crop 1999/2000.

Active Ingredient	Commercial Name	Doses		Chemical Group
		(g a.i. 100kg^{-1})	(g or ml c.p. 100kg^{-1})	
Thiamethoxam	Cruiser 700 WS	50.0	71.4	Neonicotinoids
Thiamethoxam	Cruiser 700 WS	75.0	107.1	Neonicotinoids
Thiamethoxam	Cruiser 700 WS	100.0	142.9	Neonicotinoids
Thiamethoxam	Cruiser 700 WS	125.0	178.6	Neonicotinoids
Fipronil	Standak 250 FS	25.0	100.0	Phenyl Pyrazole
Fipronil	Standak 250 FS	37.5	150.0	Phenyl Pyrazole
Fipronil	Standak 250 FS	50.0	200.0	Phenyl Pyrazole
Fipronil	Standak 250 FS	62.5	250.0	Phenyl Pyrazole
Carbofuran	Furadan 100 G	750.0[1]	7,500.0	Carbamate
Check	-	-	-	-

The flood irrigation was done 35 days after sowing. During the experiment, water was kept at constant level of 0.12 m to maintain uniform conditions for insect infestation. The initial larvae counting was done at 25 days after flood (DAF) with sampling technique adapted from TUGWELL & STEPHEN (1981): four soil and roots samples were removed from each plot with the aid of a PVC pipe section with 10 cm of diameter and 20 cm of length. The pipe was placed over the plants and forced down, until reaching depth superior to 8.5 cm. The samples were agitated under water, inside a nylon sieve with 1 mm^2 mesh to liberate the larvae from the soil and roots. The final larvae counting happened at the 40 DAF.

The granulated insecticide carbofuran was applied with the aid of a manual applicator type saltcellar, in the dosage of 7.5 kg ha^{-1} in the irrigation water, 20 days after the flood, keeping the water in the plots closed for 48 hours. This insecticide was used as standard control for rice water weevil. The harvest was done manually in the six central lines of each experimental plots, whose area corresponded to 4.8 m^2. The data were submitted to variance analysis with "SANEST" (ZONTA et al., 1986) and the means compared by Tukey test at 0.05 probability level, and the numeric data (X) for larvae, transformed in square root of X+0.50. The control efficiency of the insecticides was calculated with ABBOTT (1925) formula.

RESULTS AND DISCUSSION

Significant differences were not verified in relation to rice emergence speed, probably due to the low infestation of underground insects in the initial phase and absence of phytoxicity of the insecticides used for seed treatment (Table 2).

The main parameter evaluated in the field was the average number of *O. oryzae* larvae in soil and roots samples obtained with the PVC pipe section. In the first evaluation (25 DAF), an average of 6.4 larvae/sample was observed in the check and, in the second evaluation (40 DAF), this number was reduced to 5.8 larvae/sample (Table 3). The low infestation of rice water weevil larvae (slightly over the control level - 5 larvae/sample) in the experimental area, probably happened in function of severe drought in the region in that year, and also due to a little delay in the irrigation.

Table 2 - Effect of insecticides applied as seed treatment (g 100 kg^{-1} of seeds) on the emergence of rice plants (± SE), Embrapa Clima Temperado, Capão do Leão-RS, crop 1999/2000.

Active Ingredient	Commercial Name	Doses	Emergence of plants	
		(g a.i. 100 kg^{-1})	Initial stand[1]	%
Thiamethoxam	Cruiser 700 WS	50.0	375.3 ± 3.29 a[2]	78.2
Thiamethoxam	Cruiser 700 WS	75.0	369.0 ± 3.08 a	76.9
Thiamethoxam	Cruiser 700 WS	100.0	388.3 ± 0.85 a	80.9
Thiamethoxam	Cruiser 700 WS	125.0	378.8 ± 2.32 a	78.9
Fipronil	Standak 250 FS	25.0	372.5 ± 1.88 a	77.6
Fipronil	Standak 250 FS	37.5	393.5 ± 1.98 a	82.0
Fipronil	Standak 250 FS	50.0	364.8 ± 2.84 a	76.0
Fipronil	Standak 250 FS	62.5	399.5 ± 2.75 a	83.2
Check	-	-	339.8 ± 2.32 a	70.8
		CV (%)	7.0	

1- Initial stand in 4 linear m of a central row; 2 - Means followed by the same letter don't differ significantly at Tukey 5% probability level.

Table 3 - Effect of insecticides applied as seed treatment (g 100 kg^{-1} of seeds) or granulated in the irrigation water (g ha^{-1}) of rice field, on the larvae population of *O. oryzae* (± SE) and yield (± SE), Embrapa Clima Temperado, Capão do Leão-RS, crop 1999/2000.

Active Ingredient	Commercial Name	Doses (g a.i. 100 kg^{-1})	25 DAF[1] N[2]	25 DAF C[3]	40 DAF N	40 DAF C	Yield (kg ha^{-1})
Thiamethoxam	Cruiser 700 WS	50.0	0.7 ± 0.24 b[4]	89.1	1.4 ± 0.27 b	75.9	8,504.5 ± 12.21 a
Thiamethoxam	Cruiser 700 WS	75.0	0.4 ± 0.18 b	93.8	0.4 ± 0.20 c	93.1	8,466.1 ± 12.87 a
Thiamethoxam	Cruiser 700 WS	100.0	0.2 ± 0.16 b	96.9	0.1 ± 0.18 c	98.3	8,376.8 ± 12.96 a
Thiamethoxam	Cruiser 700 WS	125.0	0.0 ± 0.00 b	100.0	0.0 ± 0.00 c	100.0	8,683.9 ± 11.73 a
Fipronil	Standak 250 FS	25.0	0.1 ± 0.13 b	98.4	0.3 ± 0.19 c	94.8	8,707.1 ± 8.40 a
Fipronil	Standak 250 FS	37.5	0.0 ± 0.00 b	100.0	0.2 ± 0.16 c	96.6	8,358.0 ± 12.98 a
Fipronil	Standak 250 FS	50.0	0.1 ± 0.18 b	98.4	0.0 ± 0.00 c	100.0	8,867.0 ± 12.14 a
Fipronil	Standak 250 FS	62.5	0.0 ± 0.00 b	100.0	0.0 ± 0.00 c	100.0	8,292.9 ± 8.11 a
Carbofuran	Furadan 100 G	750.0	---	---	0.1 ± 0.13 c	98.3	8,320.5 ± 11.34 a
Check	-	-	6.4 ± 0.32 a	-	5.8 ± 0.34 a	-	8,178.6 ± 8.41 a
CV (%)			10.7		16.2		5.9

1- Days after flood; 2- Larvae number/sample (n = 16), numeric data for larvae transformed in square root of X + 0.50; 3 - Control percentage ABBOTT (1925) formula; 4 - Means followed by the same letter don't differ significantly at Tukey 5% probability level.

In the evaluation at 25 DAF, the seed treatment with thiamethoxam (50, 75, 100 and 125 g a.i. 100 kg^{-1} of seeds) and fipronil (25, 37.5, 50 and 62.5 g a.i. 100 kg^{-1} of seeds) efficiently controlled the larval population of *O. oryzae*, in most of the dosages with control levels above 90% (Table 3).

In the evaluations at 40 DAF, the same results were observed, with the exception of thiamethoxam in the dosage of 50 g a.i. 100 kg^{-1} seeds that differed from the other treatments and the check, showing a control level around 76%. The tested dosages of seed treatment with thiamethoxam and fipronil controlled the insect in levels comparable to the standard insecticide carbofuran (750 g ha^{-1}), applied to the irrigation water (Table 3), and in the highest dosage of the two insecticides, 100% of control was obtained in both evaluation times. Considering the obtained results, there is a possibility of reducing up to 50% the dosage of thiamethoxam (140 g a.i. 100 kg^{-1} of seeds) and up to 60% the dosage of fipronil (62.5 g a.i. 100 kg^{-1} of seeds) registered for the control of larvae of *O. oryzae,* maintaining the high efficiency. There were no significant differences among treatments in relation to rice yield (Table 3).

The potential for adoption of seed treatment is higher in areas with history of attack of underground insects with reduction of plant populations before the flood. Thus, the seed treatment, besides controlling *O. oryzae* larvae, could reduce the damage caused by pests in the pre-flood phase. Several papers on rice seed treatment to control *O. oryzae*, specially with the insecticides carbossulfan, imidacloprid, fipronil and thiamethoxam (PRANDO & PEGORARO, 1993; BOTTON et al., 1995; MARTINS et al., 1996; BOTTON et al., 1999; COSTA et al., 1999; GRÜTZMACHER et al., 1999; OLIVEIRA, 1999), show that such control measures presents highly satisfactory results, as showed in our experiment (Table 3).

The effectiveness and residual characteristics of thiamethoxam and fipronil make them excellents tool for integrated pest management on irrigated rice and allow their use for controlling insects that have developed resistance to other products, since their action mechanism differs from carbamate insecticides used, mainly the carbofuran.

Considering the obtained results, the rice seed treatment with thiamethoxam in the doses of 75, 100 and 125 g a.i. 100 kg^{-1} of seeds and fipronil in the doses of 25, 37.5, 50 and 62.5 g a.i. 100 kg^{-1} of seeds control efficiently the larvae population of *O. oryzae* up to 40 days after the flood irrigation. The rice seed treatment with the insecticide thiamethoxam in the dose of 50 g a.i. 100 kg^{-1} of seeds controls efficiently *O. oryzae* larvae only up to 25 days after the flood irrigation.

RESUMO

O efeito de inseticidas aplicados no tratamento de sementes e granulado na água de irrigação, visando o controle de larvas de ***Oryzophagus oryzae*** *(Costa Lima, 1936), foi avaliado em experimento conduzido a campo na cultura do arroz irrigado pelo sistema convencional na Embrapa Clima Temperado, em Capão do Leão-RS, no ano agrícola 1999/2000. Os inseticidas tiametoxam nas dosagens de 75, 100 e 125 g i.a. 100 kg^{-1} de sementes e fipronil nas dosagens de 25, 37,5, 50 e 62,5 g i.a. 100 kg^{-1} de sementes quando aplicados às sementes do arroz reduziram significativamente a população larval de* ***O. oryzae*** *até 40 dias após a irrigação por inundação, com eficiência de controle superior a 90%. Porém o tratamento de sementes de arroz com tiametoxam na dosagem de 50 g i.a. 100 kg^{-1} de sementes somente controlou eficientemente a bicheira-da-raiz até 25 dias após a irrigação. Não foram observadas diferenças significativas entre os tratamentos em relação à produção de grãos. Conclui-se que ambos inseticidas nas dosagens avaliadas possuem potencial para uso na cultura do arroz irrigado para o controle de larvas de* ***O. oryzae****.*

Palavras-chave: Insecta, ***Oryza sativa****, gorgulho-aquático, bicheira-da-raiz, controle químico preventivo.*

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REFERENCES

ABBOTT, W.S. A method of computing the effectiveness of an insecticide. **Journal of Economical Entomology**, v.18, p. 265-267, 1925.

BOTTON, M.; MARTINS, J.F.S.; CARBONARI, J.J.; et al. Comparação de métodos de controle químico de *Oryzophagus oryzae* na cultura do arroz irrigado. In: REUNIÃO DA CULTURA DO ARROZ IRRIGADO, 21., 1995, Porto Alegre, **Anais...** Porto Alegre: IRGA, 1995. p. 217-220.

BOTTON, M.; CARBONARI, J.J.; MARTINS, J.F.S. Eficiência de métodos de aplicação de inseticidas no controle de *Oryzophagus oryzae* (Costa Lima, 1936) (Coleoptera;

Curculionidae), na cultura do arroz irrigado. **Pesquisa Agropecuária Gaúcha**, v.5, n.1, p.71-75, 1999.

COSTA, E.C.; GUEDES, J.V.C.; COSTA., M.A.G. Controle de larvas de *Oryzophagus oryzae* (Col.; Curculionidae) com thiamethoxam em tratamento de sementes. In: CONGRESSO BRASILEIRO DE ARROZ IRRIGADO, 1. e REUNIÃO DA CULTURA DO ARROZ IRRIGADO, 23., 1999, Pelotas, **Anais...** Pelotas: Embrapa Clima Temperado, 1999. p. 439-440.

GRÜTZMACHER, A.D.; GRÜTZMACHER, D.D.; LOECK, A.E.; et al. Efeito do tratamento de sementes com inseticida thiamethoxam no controle de *Oryzophagus oryzae* (Costa Lima, 1936) (Coleoptera: Curculionidae) na cultura do arroz irrigado. In: CONGRESSO BRASILEIRO DE ARROZ IRRIGADO, 1. e REUNIÃO DA CULTURA DO ARROZ IRRIGADO, 23., 1999, Pelotas, **Anais...** Pelotas: Embrapa Clima Temperado, 1999. p.419-422.

MARTINS, J.F.S.; BOTTON, M.; CARBONARI. J.J. Efeito de inseticidas no tratamento de sementes e na água de irrigação no controle de *Oryzophagus oryzae* (Costa Lima), em arroz irrigado. **Revista Brasileira de Agrociência**, v. 2, n.1, p. 27-32. 1996.

MARTINS, J.F.S.; VERONEZ, A.B.C.; CARBONARI., J.J. Manejo integrado do gorgulho aquático (*Oryzophagus oryzae* Costa Lima, 1936) na cultura do arroz irrigado: Situação atual e perspectivas futuras. In: REUNIÃO SUL BRASILEIRA SOBRE PRAGAS-DE-SOLO, 7., 1997, Santa Maria, **Anais e Ata...** Santa Maria: CCR/UFSM, 1997. p. 68-78.

OLIVEIRA, J.V. Controle da bicheira da raiz, *Oryzophagus oryzae* (Costa Lima, 1936) com o tratamento das sementes em arroz irrigado. In: CONGRESSO BRASILEIRO DE ARROZ IRRIGADO, 1. e REUNIÃO DA CULTURA DO ARROZ IRRIGADO, 23., 1999, Pelotas, **Anais...** Pelotas: Embrapa Clima Temperado, 1999. p.415-416.

PRANDO, H.F.; PEGORARO., R.A. Controle da bicheira-da-raiz do arroz (*Oryzophagus oryzae*) (Costa Lima, 1936) (Coleoptera: Curculionidae) com tratamento de sementes. In: REUNIÃO DA CULTURA DO ARROZ IRRIGADO, 20., 1993, Pelotas, **Anais…** Pelotas: Embrapa/CPACT, 1993. p. 220-221.

TUGWELL, N.P.; STEPHEN. F.M. **Rice water weevil seasonal abundance, economic levels, and sequential sampling plants.** Fayetteville: Agricultural Experiment Station, 1981. 16p. (Bulletin, 849).

ZONTA, E.P.; SILVEIRA, P.; MACHADO, A.A. **Sistema de análise estatística (SANEST).** Instituto de Física e Matemática, UFPel, Pelotas, 1986. 399p.