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Immatures of Chironomidae (Insecta – Diptera) under the action of pesticides in irrigated rice field

Amanda Marchiori, Joele Baumart, Sandro Santos*

PPG Biodiversidade Animal, Centro de Ciências Naturais e Exatas, Universidade Federal de Santa Maria, Av. Roraima, N°1000, Bairro Camobi, Santa Maria, RS, Brasil
* Corresponding author: sandro.santos30@gmail.com

Abstract

We collected 589 larvae distributed among a control treatment and seven pesticide treatments (Only®, Imazethapyr, Imazapic, Clomazone, Quinclorac, Carbofuran and Fipronil). The most abundant genera were *Kiefferulus* spp., *Chironomus* spp. and *Dicrotendipes* spp. ANOVA showed a significant difference ($p < 0.05$) in the density of Chironomidae larvae in the first sample between the Fipronil and Control treatments. ANOSIM also showed variation in the Chironomidae community composition and trophic groups. The PRC analysis showed that the pesticide concentration was higher on the first 10 days after its application. The pesticides used in the rice crop had an initial negative effect to the Chironomidae community, dissipating during the development of the crop.

Key words: macroinvertebrates, pesticides, irrigated rice, biomonitoring.

1. Introduction

Brazil is among ten largest rice producers in the world with an annual production of 11 to 13 million tons. The state of Rio Grande do Sul (RS) stands out as the biggest domestic producer, accounting for nearly 61% of the total production in the country, with one million hectares of cultivated land (SOSBAI 2010). Rice cultivation in RS is done every year, between October and April, when the required conditions for the plant development, such as high temperature and sun radiation, occur. The development of the plant takes three stages for the development of the seedling, eight growing stages and nine stages for the reproductive period, when the plant reaches maturity and is then harvested. In dry-land sowing system, the crop is irrigated by soil submersion a few days after the emergence of the plant and sprouting some leaves (SOSBAI 2010).

Although not a natural wetland, rice paddies can be a suitable environment for several aquatic organisms and contribute to the preservation of biodiversity (Halwart 2006; Stenert *et al.* 2009). However, irrigated rice is one of the most pesticide-demanding cultures (Suhling *et al.* 2000). The Fipronil insecticide (5-amino-1-[2,6-dichloro-4-(trifluoromethyl) phenyl]-4-(trifluoromethylsulfinyl)-1H-pyrazole-3--carbonitrile) is an example of pesticide used in rice crops for the control of phytophagous insects, with a wide spectrum of activity (Ali *et al.* 1998). Its action has been reported for several groups of aquatic invertebrates, such as insects, crustaceans, molluscs, and oligochaets (Schlenk *et al.* 2001; Chaton *et al.* 2002; Shan *et al.* 2003; Mesléard *et al.* 2005; Mize *et al.* 2008), and the accumulation of insecticide in arthropods can vary, depending on how easy its penetration into the cuticle of many organisms is (Chaton *et al.* 2002).

The Carbofuran insecticide (2,3-dihydro-2-2 dimethyl-7-benzofuranyl methylcarbamate) is also commonly used in rice cultures to control insects. However, its use can stimulate the proliferation of bacteria and fungi (Das *et al.* 2003), besides affecting crustaceans and other arthropods (Matthiessen *et al.* 1995). Golombieski *et al.* (2008) studied the effect of Carbofuran on populations of cladocerans, copepods and rotifers in irrigated rice plantations, and reported the negative effect of the insecticide on cladocerans.

The herbicides used in rice crops may interfere indirectly in aquatic invertebrate communities by restricting the amount of available food due to the direct action on primary producers (Júnior *et al.* 2007). The Clomazone (2-[(2-chlorophenyl) methyl]-4,4-dimethyl-3-isoxazolidinone) and Quinclorac (3,7-dichloroquinoline-8- carboxylic acid) herbicides, for example, may have low toxicity on the cladoceran *Daphnia magna* (Nakagome *et al.* 2006), and it was found that in high concentrations (20 and 50 $ug.L^{-1}$), the presence of Clomazone in water may change the behavior of the fishes (Miron *et al.* 2004). Clomazone also has a high polluting potential of surface waters since it can be carried dissolved in water (Primel *et al.* 2005). According to Júnior *et al.* (2007), the use of Quinclorac seems to be widespread, since the herbicide was found in five river basins in the state of Santa Catarina (SC), Brazil, during rice growing seasons. This is an indication that this agrochemical can be transported out of the rice field with drained water.

The formulated mixture of Imazethapyr (5-ethyl-2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl) nicotinic acid) + Imazapic (2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)-5-methylnicotinic acid) (Only®) is one of the most used herbicides for the red rice control in rice fields in RS (Santos *et al.* 2008). The Imazethapyr herbicide, when used alone, controls developed plants and keeps the residual activity that prevents successive flows of weeds (Masson, Webster 2001). The residual activity of Only® was studied by Pinto *et al.* (2009), who found that the herbicide, when applied at a dosage of 1.0 dm^3 ha^{-1} in post-emergent irrigated rice, can remain active in the soil in an amount sufficient to diminish the average plants height, the biological yield and the weight of rye grains planted in crops rotation after one year of rice cultivation. However, there are a few studies about the action of these pesticides on biological communities, i.e., the effect of Imazethapyr, Imazapic and Only® herbicides on aquatic organisms is unknown.

The use of pesticides in rice crops can change the structure of the communities causing alterations to the trophic cascade as well as damages to adjacent water courses, thus affecting the quality of the aquatic environment (Fleeger *et al.* 2003; Faria *et al.* 2007; Mize *et al.* 2008; Vonesh *et al.* 2009). Monitoring the impact of chemical substances on the environment can be accomplished by analyzing the populations or biological communities that reflect the overall ecological integrity of the ecosystems, providing an aggregate measure of the impacts (Barbour *et al.* 1999). Aquatic invertebrates are useful tools for such monitoring since their biological, ecological and toxicological features enable to predict the effects of the pollutants, indicating deterioration or restoration of the ecosystems (Lagadic, Caquet 1998). Those organisms live all or part of their lifetime associated with the sediment, where toxins tend to accumulate, and reflect quickly the short-term environmental changes (Goulart, Callisto 2003).

Larvae of family Chironomidae are usually the most abundant aquatic invertebrates found in most freshwater habitats, also present to a distance up to thirty meters from the ocean coast (Epler 2001). The family plays an important role in the trophic chains of aquatic communities, representing the major link between the producers and secondary consumers, since their larvae, pupae and adults are food for larger invertebrates, fishes, amphibians and birds (Epler 2001). The genera of the family are not much selective in terms of food, but are subject to environmental characteristics, which may reflect the quality of the food available (Silva *et al.* 2008b).

The conflict between irrigated agriculture and the preservation of biodiversity has been considered a critical issue at a global scale (Lemly *et al.* 2000). While it is expected that treatments with pesticides are harmful to wildlife, it is important to verify the pesticides that are less harmful to the environment.

This study aimed to determine the genera of Chironomidae present in irrigated rice crops and evaluate the impact of the pesticides commonly used in this culture on the density and richness of the community, as well as observe any change in the community trophic structure in the crop during the cultivation period.

2. Materials and methods

The experiment was carried out on an experimental lowland area of the Department of Plant Science of the Federal University of Santa Maria

(UFSM), Rio Grande do Sul, Brazil, during the 2006/2007 rice season, between the months of October and February (Table I). This area has been used since the year 2003, with various pesticides, but the parcels designated as control remained the same, in order to avoid contamination. The experimental arrangement was the randomized block design with three replications (Fig. 1). Each experimental unit had 48 m² (8 × 6 m). Each block consisted of eight parcels (treatments) where the following pesticides were applied: TO – Imazethapyr + Imazapic (Only® herbicide) (75 g ha^{-1} + 25 g ha^{-1}); TIr – Imazethapyr (VEZIR® herbicide) (75 g ha^{-1}); TIc – Imazapic (PLATEAU® herbicide) (25 g ha^{-1}); TCl – Clomazone (GAMIT 500CE® herbicide) (600 g ha^{1}); TQ – Quinclorac (FACET PM® herbicide) (375 g ha^{-1}); TCa – Carbofuran (FURADAN 100® insecticide) (400 g ha^{-1}); TF – Fipronil (STANDACK® insecticide) (37.5 g ha^{-1}); TC – Control. Each pesticide dose followed technical recommendations and the minimum dose that is effective for one hectare was used.

The Fipronil insecticide was applied to the seeds (seeds treatment). Clomazone was applied during the plant pre-emergence, and the other herbicides were applied onto superficially dry soils when the seedlings were in the stage of three to four leaves. The use of the pesticides (application time and dose) was performed following technical recommendation. The irrigation of the parcels took place after the application of these pesticides during the referred stage of the rice seedling. The granular Carbofuran insecticide was applied into water 14 days after the start of irrigation. The cultivar used was IRGA 422CL. The pesticides were applied according to SOSBAI (2005) recommendations.

For the analysis of the Chironomidae fauna, soil samples were collected with the help of a 10-cm Ø core collector, 10 cm deep. Three samples per treatment were taken, on the following dates: January 3, 2007 (stabilization of the 10 cm water level – SL); January 12, 2007 (10 day) and February 22, 2007 (pre-harvest – PH). Within each plot the data was collected at the edge of the cultivated area, reaching about 20 cm in the area of rice plants (Fig. 1). We collected three samples in each plot, totalizing nine pseudoreplicates per treatment. The sediment was then washed with a 250 µm mesh sieve, and the separated material was fixed in absolute alcohol with Rose Bengal dye. In laboratory, the material was first identified to family level, and then the Chironomidae larvae were identified to genus level, with the help of a specialized identification key (Trivinho-Strixino, Strixino 1995). For this purpose, the head capsule and body were mounted on slides for analysis of the mouthparts and posterior pseudopodia. The mounting medium was Hoyer solution with 48 hours in oven at 40°C (Trivinho-Strixino, Strixino 1995). The larvae were classified regarding their feeding habits as predator, collector-gatherer, collector-filterer, scraper or shredder, according to Mandaville (2002).

The environmental factors measured during the experiment were dissolved oxygen, using oximeter YSI, model Y5512; pH, using Hanna pH meter, model HI8424; total hardness of water, according to APHA (1992), and conductivity, using a portable conductivity meter Mart, model MB11. The differ-

Table I. Rice cycle of the experimental area used in this study in the crop year 2006/2007, in Santa Maria, RS. Brazil.

Month	Rice Cycle
October 2006	Soil preparation and fertilization. Seed treatment with Fipronil insecticide one day before sowing, as recommended. 25th day: Sowing.
November 2006	Seedling germination. Application of Clomazone, which is a pre-emergent herbicide.
December 2006	Seedling development. 15th and 16th days: Application of Only®, Imazethapyr, Imazapic and Quinclorac, which are post-emergent herbicides. 17th day: Flooding.
January 2007	Development, growing and flowering of rice. 1st day: Application of Carbofuran insecticide. 2nd day: Stabilization of the 10 cm water level. 3rd day: First sample. After the stabilization of water level. 12th day: Second sample. Reflects the direct effect of pesticides on the community that was being established.
February 2007	Panicle filling and grain ripening. 22th day: Third sample. Reflects the community structure at the end of the culture, when theoretically the pesticides are already dispersed. 23th day: Drying and harvest.

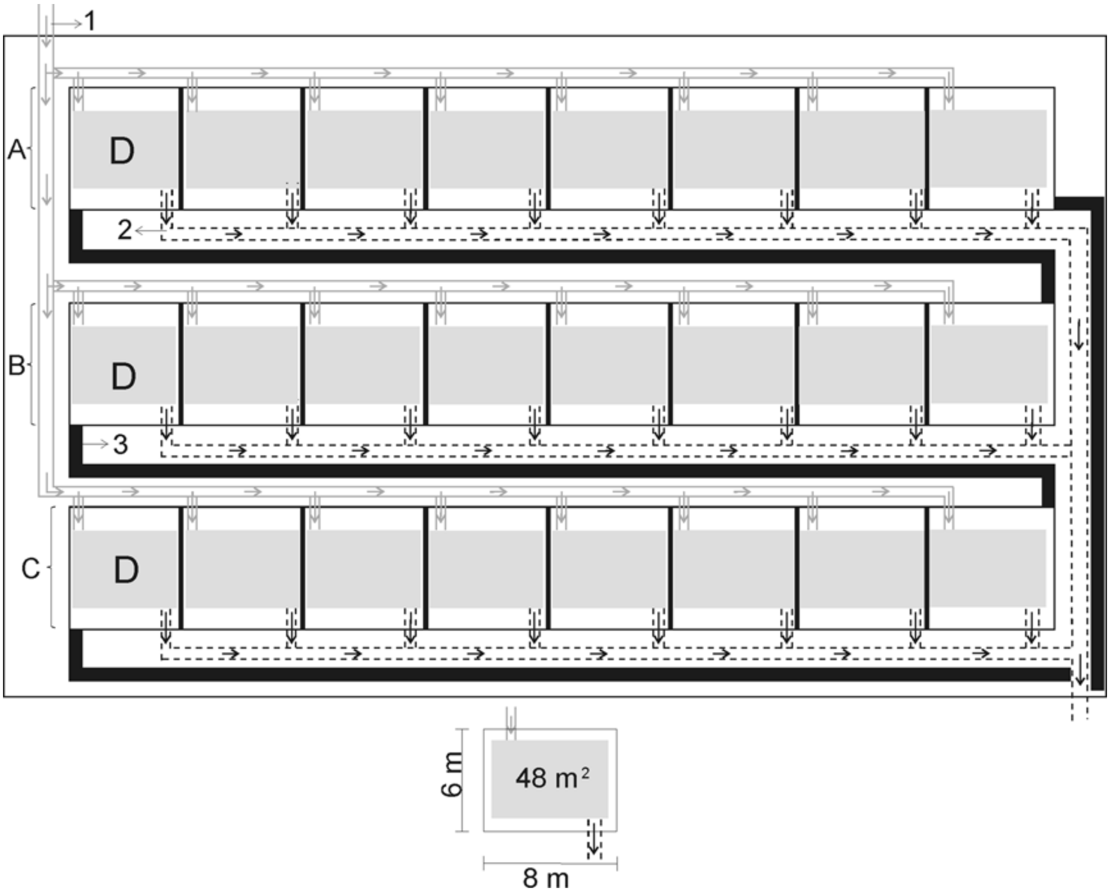

Fig. 1. Scheme of the experimental area used in this study during the crop year of 2006/2007, in Santa Maria, RS, Brazil. 1: Inlet clean water pipe to the blocks. 2: Outlet water pipe from the plots. 3: Plot divisions (prevents contaminated water from mixing with clean water.) A: First block, B: Second block, C: Third block. D: Control area (receives the first clean water). Shaded area corresponds to the area cultivated with rice. Size of each plot on detail.

ence between means of environmental factors was assessed by analysis of variance (one-way ANOVA), using BioEstat Version 5.0. The Chironomidae zoobenthic density data were submitted to the analyses of ANOVA assumptions, and after meeting the stipulations and being transformed for data normalization (log x + 1), they were submitted to one-way ANOVA, and the means separated by Tukey test ($p < 0.05$). The treatment, day and genus variables were submitted to an analysis of similarities (ANOSIM) using the Bray-Curtis distance measure and 10 000 randomizations to find whether there was a significant difference ($p < 0.05$) in the community composition during the sampling days, using Past. These variables were also used in the analysis of the principal response curve (PRC), using R version 2.11.1 (The R Development Core Team, 2010), which determined how long the Chironomidae community was under the action of pesticides. The variation among the trophic groups was determined by ANOSIM, using the Bray-Curtis distance measure and 10 000 randomizations.

3. Results

The average values of dissolved oxygen, pH, total water hardness and conductivity were 6.9 (±1.12), 7.14 (±0.46), 2.39 (±2.69) and 110.70 (±30.12), respectively. The ANOVA result on the environmental factors confirmed that these variables did not show a significant difference among the sampling treatments ($F = 0.0412$; $F = 0.3157$; $F = 0.3633$; $F = 0.0441$; respectively; $df = 7$).

The total sampling number in the eight treatments, in the three sampling occasions, was 589 animals, distributed in 16 genera. The larvae identification and the respective densities, in each sampling occasion, are presented in Table II. The most representative genera found in the samples taken from the stabilization of water level (SL) were *Kiefferulus*, *Chironomus* and *Dicrotendipes*, all belonging to the subfamily Chironominae. In the pre-harvest (PH) sample, the dominant genera were *Nimbocera*, *Coelotanypus* and *Tanypus*, the first belonging to the subfamily Chironominae and the others to Tanypodinae.

The ANOSIM showed a significant difference in the Chironomidae community richness among the treatments during the sampling occasions. In SL samples (R = 0.222), eight genera were found, and all of them, with the exception of *Nimbocera*, were represented in TC (Table II), the treatment that showed the greatest richness in the sampled days, followed by TIr, TIc and TCa, all of them with four genera, and TCl, TQ and TF, which presented three genera each. The genus *Nimbocera* was only found in the TCa treatment. For this sampled occasion, the TO treatment did not show any presence of Chironomidae and so it was excluded from the analysis. *Chironomus*, *Dicrotendipes* and *Goeldichironomus* were recorded exclusively in this sample.

The 10 day sample showed only two genera *Pseudochironomus* and *Tanypus*, the first found only in that sample day. Both genera were sampled in TC, and no organism was recorded in the other treatments (Table II). In the PH sample, the ANOSIM result showed homogeneity among the treatments (R = -0.01802), and the genera were more evenly distributed. Twelve genera were found, from which *Ablabesmyia*, *Coelotanypus*, *Labrundinia*, *Larsia*, *Monopelopia*, *Pentaneura* and *Tanytarsus* were recorded only in this sample (Table II).

By comparing the two sampling occasions with more records (SL and PH) by means of ANOSIM, a significant difference in the composition of the treatments was found (R = 0.1884; $p < 0.05$). Among the 16 genera in all samples, only *Tanypus* and *Polypedilum* were recorded for the two sampling days (Table II).

With regard to the Chironomidae density, the ANOVA result showed a significant difference ($p < 0.05$) in the abundance of Chironomidae only for the SL sample, between TF and TC. For TO, the Chironomidae community was established only in the last sample (PH); therefore, this treatment was excluded from the analysis of the SL and 10 day

Table II. Genera of Chironomidae identified and their mean densities (individuals m^{-2}) in the three replicate samples from water level stabilization (SL), 10 day and pre-harvest (PH), in irrigated lowland rice field at the Federal University of Santa Maria, RS, Brazil, in the crop year of 2006/2007. (Treatments: TO = Only®, TIr = Imazethapyr, TIc = Imazapic, TCl = Clomazone, TQ = Quinclorac, TCa = Carbofuran, TF = Fipronil, TC = Control).

	TO	TIr	TIc	TCl	TQ	TCa	TF	TC	TOTAL
SL									
Kiefferulus	0	8000	32000	7000	6000	21000	333.33	57000	131333.3
Chironomus	0	1333.33	333.33	5000	0	13666.67	0	2333.33	22666.66
Dicrotendipes	0	666.66	333.33	1666.66	666.66	7000	666.66	7666.66	18666.63
Tanypus	0	333.33	0	0	0	0	666.66	2333.33	3333.32
Goeldichironomus	0	0	1333.33	0	0	0	0	1333.33	2666.66
Nimbocera	0	0	0	0	0	666.66	0	0	666.66
Clinotanypus	0	0	0	0	0	0	0	333.33	333.33
Polypedilum	0	0	0	0	0	0	0	333.33	333.33
TOTAL	0	10333.32	33999.99	13666.66	6666.66	42333.33	1666.65	71333.31	
10 day									
Tanypus	0	0	0	0	0	0	0	1000	1000
Pseudochironomus	0	0	0	0	0	0	0	333.33	333.33
TOTAL	0	0	0	0	0	0	0	1333.33	
PH									
Nimbocera	333.33	333.33	0	0	333.33	333.33	0	666.66	1999.98
Coelotanypus	333.33	0	333.33	0	0	333.33	333.33	333.33	1666.65
Tanypus	0	333.33	0	0	333.33	666.66	0	333.33	1666.65
Ablabesmyia	0	0	333.33	666.66	0	0	0	0	999.99
Labrundinia	1000	0	0	0	0	0	0	0	1000
Tanytarsus	0	0	0	666.66	0	0	0	0	666.66
Clinotanypus	0	0	333.33	0	0	0	0	0	333.33
Kiefferulus	0	0	0	333.33	0	0	0	0	333.33
Larsia	0	0	333.33	0	0	0	0	0	333.33
Monopelopia	0	0	0	0	0	0	0	333.33	333.33
Pentaneura	0	0	0	0	0	333.33	0	0	333.33
Polypedilum	0	333.33	0	0	0	0	0	0	333.33
TOTAL	1666.66	999.99	1333.32	1666.65	666.66	1666.65	333.33	1666.65	

samples. Regarding the density of the genera among the treatments, the ANOVA result showed a significant difference ($p < 0.05$) for four sampled genera (Table III). *Ablabesmyia*, *Clinotanypus*, *Coelotanypus*, *Labrundinia*, *Larsia*, *Monopelopia*, *Nimbocera*, *Pentaneura*, *Polypedilum*, *Pseudochironomus*, *Tanypus* and *Tanytarsus* showed no significant difference among the treatments in the sampling days in which they were recorded. *Kiefferulus* showed significant difference only in the SL sample, not present in the PH sample (Table III).

The PRC showed that the action of pesticides takes place in the first days of contact of these animals with the chemicals (SL and 10 day). However, after the initial stress, the Chironomidae begin colonizing the treatment parcels (PH) again (Fig. 2). The predominant trophic guilds were collector-gatherer in the SL sample, in which the genera belonging to the subfamily Chironominae were more abundant, and the predator in the PH sample, in which the genera of the subfamily Tanypodinae prevailed. The R values in ANOSIM on the trophic groups among the sampling days for each treatment showed that TO, TIc, TCl, TCa and TC ($R = 0.5926$; $R = 1$; $R = 0.4938$; $R = 0.4815$ and $R = 0.1029$, respectively) presented variations, but the p values showed that these variations were not significant. TIr, TQ and TF did no present variations along the experiment ($R = -0.05556$; $R = -0.3704$ and $R = -0.0535$, respectively).

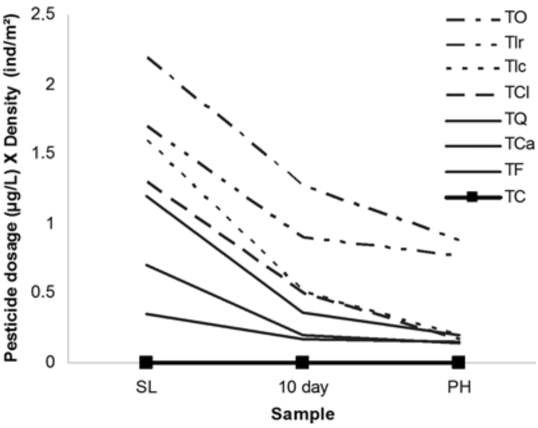

Fig. 2 Analysis of the ratio of the pesticides dosage (µg/L) by the organisms density (individuals/m^2), by principal response curve analysis (PRC), in the samples collected from irrigated rice field at the Federal University of Santa Maria, RS, Brazil. (SL = stabilization of the water level, PH = pre-harvest; Treatments: TO = Only®, TIr = Imazethapyr, TIc = Imazapic, TCl = Clomazone, TQ = Quinclorac, TCa = Carbofuran, TF = Fipronil, TC = Control).

Table III. ANOVA results on density (individuals m^{-2}) of the genera of Chironomidae identified in the sample from water level stabilization (SL) in irrigated lowland rice field at the Federal University of Santa Maria, RS, Brazil, in the crop year of 2006/2007. (Treatments: TO = Only®, TIr = Imazethapyr, TIc = Imazapic, TCl = Clomazone, TQ = Quinclorac, TCa = Carbofuran, TF = Fipronil, TC = Control).

Genera	Sample	Treatments	F; df; p
Chironomus	SL	TO – TCa	F = 608.2271; df = 1; p ≤ 0.001
		TIc – TCa	F = 9.1601; df = 1; p = 0.039
		TQ – TCa	F = 608.2271; df = 1; p ≤ 0.001
		TCa – TF	F = 608.2271; df = 1; p ≤ 0.001
Dicrotendipes	SL	TO – TIc	F = 187.0314; df = 1; p ≤ 0.001
		TO – TCa	F = 250.2645; df = 1; p ≤ 0.001
		TO – TC	F = 111.5826; df = 1; p ≤ 0.001
Goeldichironomus	SL	TO – TC	F = 957.5843; df = 1; p ≤ 0.001
		TIr – TC	F = 957.5843; df = 1; p ≤ 0.001
		TCl – TC	F = 957.5843; df = 1; p ≤ 0.001
		TQ – TC	F = 957.5843; df = 1; p ≤ 0.001
		TCa – TC	F = 957.5843; df = 1; p ≤ 0.001
		TF – TC	F = 957.5843; df = 1; p ≤ 0.001
Kiefferulus	SL	TO – TCl	F = 64.6111; df = 1; p = 0.002
		TO – TCa	F = 1952.2395; df = 1; p ≤ 0.001
		TO – TC	F = 2296.5545; df = 1; p ≤ 0.001
		TCl – TC	F = 8.9335; df = 1; p = 0.040
		TCa – TF	F = 10.7793; df = 1; p = 0.031
		TCa – TC	F = 9.8300; df = 1; p = 0.035
		TF – TC	F = 13.8033; df = 1; p = 0.021

4. Discussion

In the SL sample, *Chironomus*, *Dicrotendipes* and *Kiefferulus* had the highest density recorded. *Chironomus* is considered ecologically versatile, because it colonizes areas in the most varied conditions and its abundance may increase as a response to organic enrichment (Marques *et al*. 1999; Stevens *et al*. 2006; Silva *et al*. 2008a). *Dicrotendipes* is a typical organism of agricultural areas (Rae *et al*. 1989), recorded in streams impacted by rice crops (König 2009). *Kiefferulus*, although considered uncommon in rice growing areas in Australia (Stevens *et al*. 2006), it is widely found in farming areas in the central region of Thailand (Domingues *et al*. 2007). As to the genera with the highest density in the 10 day and PH samples, *Pseudochironomus* and *Nimbocera* have been found in streams under anthropic disturbances and vegetation being restored (Suriano, Fonseca-Gessner 2004), as well as in good quality waters (Callisto *et al*. 2001a).

All organisms found had their densities reduced after the application of pesticides. The agrochemicals had the highest impact on the Chironomidae community at the 10 day sample, in which organisms were found only at TC. The herbicide application is directed to the control of weeds rather than aquatic insects larvae. The application of the herbicide Ecomex® favored the Chironomidae population growth in Malaysian rice fields (Al-Shami *et al*. 2010), while Faria *et al*. (2007) reported no effect of the herbicides Molinato and Propanil on *Chironomus riparius* larvae. However, our experiment showed that herbicides and insecticides had a similar impact over Chironomidae fauna.

Detection of the herbicide Clomazone in water after its application can occur during 13 days (Santos *et al*. 2008) and even in 24 days (Noldin *et al*. 2001), and in the soil the herbicide can remain for 26 days (Santos *et al*. 2008). Therefore, it is expected that the effect of the herbicide be higher during this time interval, as shown in this study. In the case of Quinclorac, Júnior *et al*. (2007) reported that after its application in rice fields there is a decreasing abundance of phytoplankton community, and its recovery may take up to ten days. Since the benthonic community depends on phytoplankton for food, it is expected that its recovery takes place in a period of more than 10 days. Similar effect for the action of Quinclorac was found by Baumart, Santos (2010), who reported that Quinclorac had the greatest impact on the benthonic community among the pesticides examined in their study. Moreover, Daam *et al*. (2009) reported that the application of the herbicide Linuron on an experimental microcosm led to an alteration of the algal community, eliminating some the sensitive species, which were the more digestible to the zooplankton. As the tolerant algal species were less favorable to the zooplankton, the abundance of these organisms also decreased along the experiment (Daam *et al*. 2009). Since the benthonic community depends on phytoplankton for food, it is expected that its recovery takes place only after the phytoplankton community recovery.

For Imazapic and Imazethapyr herbicides, larvae were also only recorded in the SL and PH samples. However, in the treatment with Only®, the Chironomidae community was established only in PH, with no record of larvae in the samples collected earlier. Apparently, among the agrochemicals used in the study, the impact of Only® on the Chironomidae community was the most negative. However, Baumart and Santos (2010) found that Only® had higher average density and richness on the benthic community when compared to herbicides like Bispyribac-Sodium and Quinclorac. For Imazapic and Imazethapyr, there is no record of its individual action on biological communities.

The Carbofuran insecticide reaches its concentration peak after three days of application, decreasing gradually until the minimum dose can be detected after 21 days (Marei *et al*. 2000). In our experiment this insecticide showed low influence on the Chironomidae community in the SL sample, but in the 10 day no organism was recorded. In the PH sample, community began to grow again. Al-Shami *et al*. (2010) reported that the Carbofuran application on the rice field had a negative effect on chironomids, being presumably more toxic than Fipronil. A similar effect was found on *Daphnia magna* in laboratory conditions (Herbrandson *et al*. 2003), when it was observed that the toxicity on the population of cladocerans increased with a higher concentration of insecticide.

Fipronil can provide control from 9 to 14 days on larvae of the subfamily Chironominae and over 29 to 34 days on Tanypodinae (Stevens *et al*. 1998). In this study, no larvae were found in the 10 day and only a few *Coelotanypus* (Tanypodinae) were found in the PH sample. Mize *et al*. (2008), also in rice-growing areas, noted a change in the dominant taxa, where farming activities and the concentrations of Fipronil were higher – from insects to non-insects, like Oligochaeta.

Regarding the trophic guilds, the subfamily Tanypodinae is usually represented by predators, while detritus is more common in the Chironominae diet (Henriques-Oliveira *et al*. 2003). The abundance of predatory genera belonging to Tanypodinae and found in PH can be related to better environmental conditions, allowing a greater variety of potential preys for these organisms (Silva *et al*. 2008a). However, genera found in the samples such as *Ablabesmyia*, *Clinotanypus* and *Tanypus*, which are considered predators (Mandaville 2002; Zilli *et al*. 2008; Silva *et al*. 2009), showed detritivorous habits in a study conducted by Silva *et al*. (2008b), were the stomach contents of chironomids were analysed. Likewise, *Polypedilum* showed detritivory and collector habits in many studies (Henriques-Oliveira *et al*. 2003; Silva et al. 2008a), although it is considered a shredder species (Mandaville 2002; Zilli *et al*. 2008). Therefore, as the environmental changes determine the predominant populations, the organism's adaptations, reflected in the proportions of trophic groups and different ways of using the primary resources, they also function as responses to the most diverse environmental impacts (Callisto *et al*. 2001b).

This study resulted in the identification of 16 genera of a Chironomidae in samples taken from irrigated rice fields in southern Brazil. Such fauna characterization is significant, given the scarce information on these organisms in rice wetland cultures. Regarding the pesticides applied in the field, it can be seen that its initial effect was negative on the Chironomidae community. Although environmental factors not examined in this study might also have contributed to the results, as a function of the small amount of organisms found in the control treatment, the action of pesticides on the immatures of Chironomidae was apparently more intense close to the ten days after their application. During the crop season, the increase in the richness found suggests that the community would be restoring, which can be attributed to the dissipation of the pesticides effects. The recovery of the area, which is not fully healthy, is achieved with different taxa from those originally occupying the area. It can indicate a succession of the taxa or yet an opportunistic behavior of these organisms, as there are some vegetable species that can be consumed and, then, animals for the predators, thus enabling the community restoration. Despite the community restoration, the pesticide application changed the colonization pattern of the rice crop and consequently the structure of the chironimid community. Seeing the benthic community as a whole, these disturbances can bring consequences like the alteration of the trophic cascade, interfering on the community dynamics, modifying the feeding pattern and altering the development of benthic communities. Because of the small size and high abundance of these organisms they occupy a unique place at the trophic cascade, so the community can be affected on a long term. As chironomids, other benthic animals may have been affected by the pesticides, some of them that could be important even to the rice crop. Some predator arthropods that develop at the rice culture can act like natural enemies to plagues, so the use of pesticides should be held to a more selective level to avoid unnecessary environmental damages. Although the pesticides have dissipated from water, their persistence in the sediment can be longer, continuing to affect the benthic organisms. Future studies should be made to evaluate the influence of this factor, associating different levels of trophic cascade and soil analysis.

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