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SHORT PAPER

Acute Toxicity of Fluazifop-p-butyl (Herbicide) on *Oreochromis niloticus* (L., 1754) Larvae

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Abstract

In this study, aquatic environments adversely impact, which may occur in order to obtain information about the acute toxicity Fluazifop-p-butyl (herbicide) which is widespread used in agriculture in the Çukurova Region, has been researched using the larvae *Oreochromis niloticus* (L., 1754). In the present study, the test fish *O. niloticus* larvae (average weight 1.88±0.6 g, average length 5.04±0.5 cm) were obtained from the Çukurova University Fisheries Faculty Freshwater Fish Research and Application Station. In the experiment, five different concentrations along with the control group were used making a total of 12 aquariums. Each experiment was repeated two times. In this research, the static method of the acute bioassay methods was applied. The experiments were conducted under laboratory conditions at 25±2°C. The results have been predicted with the dose-response data and were fitted with a log-logistic model by using R 3.0 statistical computation environment and DRC library. The 24 h acute LC_{50} value was determined. According to the conclusions, acute toxic effects investigated Fluazifop-p-butyl (herbicide), the 24 h LC_{50} acute toxic lethal concentration value for *O. niloticus* larvae was calculated to be 1.94±0.02 mg L^{-1}. These results indicate that low levels of Fluazifop-p-butyl (herbicide) in the aquatic environment may have a significant effect on the O. niloticus populations.

Keywords: Bioassay, Herbicide, Fluazifop-p-butyl, *Oreochromis niloticus*, LC_{50}.

Fluazifop-P-Butyl (Herbisit)'in *Oreochromis niloticus* (L., 1754) Yavruları Üzerine Akut Toksik Etkisinin Araştırılması

Özet

Bu çalışmada, Çukurova Bölgesi'nde tarım alanlarında yaygın olarak kullanılan Fluazifop-p-butyl (herbisit)'in *Oreochromis niloticus* (L., 1754) yavruları üzerine akut toksik etkisi araştırılmıştır. Laboratuvarda 25±2°C'de yürütülen çalışmada, statik biyodeney yöntemi kullanılmış; deneysel sonuçlar log-logistic model istatistik analiz yöntemiyle incelenmiş ve 24 saatlik akut LC50 değeri hesaplanmıştır. Akut toksik etkisi araştırılan Fluazifop-p-butyl (herbisit)'in, *O. niloticus* yavrularına ait 24 saatlik öldürücü konsantrasyon değeri, LC50 1,94±0,02 mg L^{-1} olarak hesaplanmıştır.

Anahtar Kelimeler: Biyodeney, Herbisit, Fluazifop-p-butyl, *Oreochromis niloticus*, LC_{50}.

Introduction

Pesticides are needed to be fully considered and understood due to their immense toxicity. Their decomposition is quite difficult and they can accumulate in the environment and on the living organisms alike. In water, heavy pollution of pesticides causes a shortage of oxygen and so leads to toxication. It leads to a mass mortality of fish and other organisms (Çelikel, 2011).

In this study the aim was to evaluate the effects of fluazifop-p-butyl, a herbicide widespread used in agriculture throughout the Çukurova Region. Fluazifop-p-butyl is used for the postemergence control of volunteer cereals, wild oats, and annual and perennial grass weeds in oilseed rape, potatoes, fodder beet, sugar beet, vegetables, pome fruit, cotton, soya beans, stone fruit, bush fruit, citrus fruit, pineapples, strawberries, vines, bananas, alfalfa, sunflowers, ornamentals and other broad-leaved crops. It is non-phytotoxic to broad-leafed crops (FAO, 2000).

In the environment, fluazifop-p-butyl is degraded primarily through microbial metabolism and hydrolysis. It is not degraded easily by sunlight. The

half-life of fluazifop-p-butyl in soils is one to two weeks. Although it binds strongly with soils, fluazifop-p-butyl it is not highly mobile and is not likely to contaminate ground water or surface water through surface or subsurface runoff. In water, fluazifop-p-butyl is quickly hydrolyzed to fluazifop acid, which is stable in water. Fluazifop-p-butyl is of comparatively low toxicity to birds and mammals, but can be highly toxic to fish and aquatic invertebrates (Tu *et al*., 2001).

Fluazifop-p-butyl has low toxicity levels when pertaining to mammals and most other wildlife, but may negatively effects aquatic flora and fauna. For this reason, extra care should be exercised when applying close to natural bodies of water (Britt *et al*., 2003).

Fluazifop-p-butyl may be highly to moderately toxic for fish, but only slightly toxic to other aquatic species, such as invertebrates. The reported 96-h LC_{50} values for the technical product in fish species are 0.53 mg L^{-1} in bluegill sunfish and 1.37 mg L^{-1} in rainbow trout, indicating very high toxicity levels. The 48 h LC_{50} in *Daphnia magna* (an aquatic invertebrate) is reported as greater than 10 mg L^{-1}, indicating solely slight toxicity levels as listed accordingly (EXTOXNET 1996).

In this study, to produce and gather information about the possible negative effects of Fluazifop-p-butyl on the aquatic environment; acute toxic effects of Fluazifop-p-butyl, which widely used in agricultural Çukurova Regions, on *Oreochromis niloticus* (L., 1754) larvae are investigated by the static test method of acute toxicity test was used.

Materials and Methods

In this study, the test fish *Oreochromis niloticus* (L., 1754) larvae (average weight 1.88±0.6 g, average length 5.04±0.5 cm) were obtained from the Çukurova University Fisheries Faculty Freshwater Fish Research and Application Station.

In this study, the static method of the acute bioassay methods was applied (APHA, AWWA, WEF, 1998). Fish were taken to stock the aquariums for adaptation to the laboratory conditions. Two days prior to the experiment was stopped feeding the fish. In the experiment 20x40x30 cm glass aquariums were used and pH, oxygen values in both the stock and the experiment aquariums were observed.

The research includes two sections; preliminary and main experiments. The concentration determined in preliminary experiments were used in the main experiments. In the study, five different concentrations (1.7, 1.8, 1.9, 2.0, 2.1 mg L^{-1}) together with the control group (0.0 mg L^{-1}) were used in a total of 12 aquariums. Each experiment was repeated twice.

First, Fluazifop-p-butyl (50 g L^{-1}) was prepared. The concentrations used in the preliminary and main experiments were then taken from these stock solutions.

As a result of the experiments, the mortality rates of fish were determined 50%. The results have been calculated with the dose-response data that were fitted with a log-logistic model (Jeske *et al*., 2009) by using R 3.0 (R Core Team, 2013) statistical computation environment and DRC library (Ritz and Streibig, 2005).

Results

The experiments were conducted under laboratory conditions at 25±2°C, pH, 7.9-8.1 dissolved O_2 7.3-4.2 mg L^{-1}. The calculated 24 h acute LC_{50} value (95% confidence limits) of Fluazifop-p-butyl, using a static bioassay system for *O. niloticus*

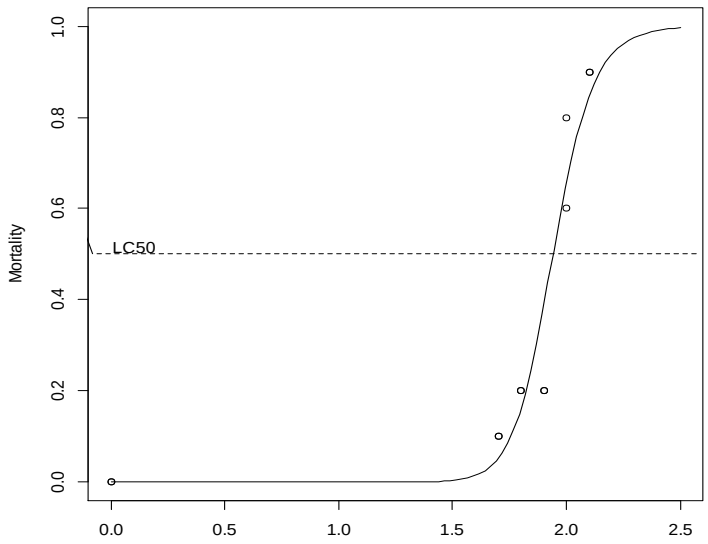

Figure 1. LC_{50} value of *O. niloticus* for 24 hours.

was 1.94±0.02 mg L^{-1} (Figure 1).

No mortality was observed in the control group during the experiment. The control group showed normal behaviour during the test period. The changes in behavioural response started after dosing, depending on the concentration of toxicant. Fish were constantly swimming sideways, losing balance and color fading was observed.

Discussion

Various values are different found in sources about the LC_{50} values from the tests done to determine the effects of pesticides on fish. There are some reasons of these differences, such as the biology of the fish, living conditions, chemical and physical properties of the water and the methods applied (Fındık *et al*., 2001).

As a result of the experiments, Fluazifop-p-butyl (herbicide) the 24 h LC_{50} acute toxic lethal concentration value for *Oreochromis niloticus* (L., 1754) larvae was determined to be 1.94±0.02 mg L^{-1}.

Some results of the toxicity studies were performed with Fluazifop-p-butyl:

LC_{50} value for 96 h for *Cyprinus carpio* was determined as 1.31 mg L^{-1} (FAO, 2000), LC_{50} value for 96-h for *Oncorhynchus mykiss* was determined as 1.411 mg L^{-1} (FAO, 2000), 1.37 mg L^{-1} (EXTOXNET-1, 1996) and 5.6 mg L^{-1} (Helfrich *et al*., 2009), LC_{50} value for 48-h for *Tilapia nilotica* was determined as 0.29 mg L^{-1} (Tarzwell and Henderson, 1960), LC_{50} value for 96-h for *Lepomis macrochirus* was determined as 0.53 mg L^{-1} (EXTOXNET-2, 1996), LC_{50} value for 96-h for *Salmo gairdneri* was determined as 0.73 mg L^{-1} (Hamburg *et. al.,* 1989; Montgomery, 2007) have been reported. These results indicate that low levels of Fluazifop-p-butyl (herbicide) in the aquatic environment may have a significant effect on the *O. niloticus* populations.

According to these conclusions; LC_{50} value that we have found for a herbicide Fluazifop-p-butyl is compliant with the report of FAO (2000), It is thought that, the reasons of the differences with other reports are, pesticide formulation, ambient temperature, fish species, length and age.

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