

STRESS RESPONSE OF JUVENILE LARGEMOUTH BASS EXPOSED TO SUBLETHAL LEVELS OF FIVE COMMONLY USED AQUATIC HERBICIDES

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Introduction

The excessive growth of aquatic plants interferes with recreational activities in ponds and lakes. Aquatic herbicides are often used to control vegetation in these environments. These herbicides are thought to be safe for fish and aquatic invertebrates because laboratory studies show that the herbicides are toxic at levels much higher than their legally permitted application rates. The primary objective of our study was to measure the stress response in juvenile largemouth bass, *Micropterus salmoides*, that were exposed to the following aquatic herbicides: diquat, endothall, 2,4-D, fluridone, and glyphosate (Rodeo). The concentrations of the herbicides used for each experiment were 0, 0.1X, 1.0X, and 10.0X mg/L (control, low, medium, and high), where X was the legal application rate of the herbicide. Blood was sampled from the sacrificed fish at 2, 8, 24, and 48 hours of exposure. We measured cortisol, glucose, and osmolality in the sacrificed fish.

Results and Discussion

An analysis of glucose and osmolality levels showed that the intensity and the rate of occurrence of the stress response varied with each herbicide. These differences were also associated with the concentration of the herbicide and the length of exposure. Of the five herbicides tested, glyphosate elicited the lowest stress response in the bass. This response was not related to either dose or exposure period. For the glyphosate study, there was little difference in glucose and osmolality values between the controls and the different concentrations throughout the experiment. 2,4-D elicited the most intense stress response in the bass. This response was dose dependent but was not affected by the length of the exposure period. The magnitude of the stress response was greater for 2,4-D than for any other herbicide tested. The bass exhibited a similar stress response

to diquat as they did to 2,4-D (i.e. dose dependent only), however, the intensity of this response was much lower. Fluridone elicited both a time and dose related response in the bass. Glucose values increased, while osmolality values decreased throughout the experiment. There was little variation in the response of the bass to the medium and high concentrations of fluridone. Juvenile largemouth bass exposed to endothall appeared to acclimate to the presence of the herbicide. Their stress response peaked at eight hours and decreased to near control values between 24 and 48 hours of exposure. As with fluridone, the responses of the bass to the medium and high concentrations of endothall were similar, while their responses to the low concentration was only slightly higher than the controls.

The results of this study suggest that of the aquatic herbicides tested, glyphosate and endothall may be the least stressful herbicide to juvenile largemouth bass. We arrived at this conclusion primarily because glyphosate elicited the smallest stress response in the bass, and because the juvenile bass were able to acclimate to the presence of relatively high levels of endothall within a short period of time. These data will provide useful management information to agencies and landowners as to the most benign aquatic herbicide available with respect to maintaining a healthy largemouth bass population

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