

Accumulation of heavy metals by earthworms in boron-contaminated area (Kırka-Eskişehir)

(Oligochaeta: Lumbricidae)

Naime Arslan, Arzu Çiçek, Cansev Akkan, Deniz Kılınç, Emrah Acı

Abstract. Boron is a naturally occurring material and is used in domestic and industrial products. Kırka region possesses the largest boron deposits not only in Turkey but also in the world. Even though boron is an essential nutrient for plants and an essential element for many organisms, certain concentrations can be toxic to aquatic and terrestrial organisms. This paper investigates the concentration of boron in soil and an earthworm (*Eiseniella tetraedra*) collected from five sampling sites at different times during the year 2008 from surrounding areas of the Kırka county of Eskişehir. Because the adsorption of borates into soils is controlled by the presence of aluminum and iron, earthworms and soil were also analyzed for aluminum and iron. Our results show that earthworm samples accumulated more boron than soil and at five sampling sites aluminum and iron were present in soil at relatively high concentrations.

Key words. Earthworms, accumulation, boron, Kırka.

Introduction

Boron is a naturally occurring element that is found in the form of borates in sedimentary rocks, coal, shale, and some soils. It is widely distributed in nature, with concentrations of about 10 mg/kg in the Earth's crust (range: 5 mg/kg in basalts to 100 mg/kg in shales) (WHO 1998). Economic borate deposits are rare, occurring in arid regions of Turkey, USA, Argentina, Chile, Russia, China, and Peru. The Turkish Borate deposits occur in western Anatolia in five main districts: Bigadiç, Kestelek, Sultançayır, Emet and Kırka. They formed in a lacustrine environment during periods of calc-alkaline volcanic activity in the Neogene (PALMER & HELVACI 1995).

Boron enters the environment mainly through the weathering of rocks, boric acid volatilization from seawater, and volcanic activity. Boron is also released from anthropogenic sources to a lesser extent. Anthropogenic sources include agricultural, refuse, and fuel wood burning, power generation using coal and oil, glass product manufacture, use of borates/perborates in the home and industry, borate mining/processing, leaching of treated wood/paper, and sewage/sludge disposal. Many of these sources are difficult to quantify (WHO 1998). Boron is an essential nutrient for plants, but can be toxic to aquatic and terrestrial organisms especially when accumulated in high concentrations (ÇÖL & ÇÖL 2003). The concentrations of many elements, including boron, are increasing in aquatic ecosystems due to anthropogenic activities.

Earthworms are among the major components of soil biomass and play an important role in maintaining the structure and fertility of soil. Among the earthworms, *Eiseniella tetraedra*