EFFECT OF SOIL AMENDMENTS ON CHROMIUM AND NICKEL UPTAKE IN LOWLAND RICE SOILS AFFECTED BY MINING ACTIVITIES

Venus O. Saz*, Pearl B. Sanchez, Erlinda S. Paterno, Veronica P. Migo and Pompe C. Sta. Cruz

Cebu Technological University-Tuburan Campus, Tuburan, Cebu and Agricultural Systems Institute-Division of Soil Science, University of the Philippines Los Banos 4031, Philippines

ABSTRACT

The presence of Cr and Ni, in agricultural land particularly in rice paddies as affected by mining activities represents a major risk to human health. Since, rice is widely cultivated globally, especially in southeastern Asia, and is a staple food for many people. It has been shown that rice accumulates considerable amounts of heavy metals in its grains (Singh et. al., 2010). Therefore, rice is assumed to be an important source of dietary heavy metal intake for people who consume it regularly. The danger of Cr and Ni bioaccumulation in the food chain represent one of the major environmental and health problems of modern society. Infact, application of soil amendments is very important to remove or minimize the concentration of these pollutants. These amendments are organically based coming from agro-industrial waste such as vermicast, carbonized rice hull, and bagasse ash/ sugarcane mill ash. Another material used is known as zeolite, this is a natural mineral with microporous and naturally-occurring hydrated aluminosilicate minerals commonly used as commercial adsorbents and catalysts. Thus, the study was conducted to determine the effect of different soil amendments applied (vermicast, carbonized rice hull, bagasse ash and zeolite) on the accumulation and translocation of Cr and Ni in rice at various growth stages of the crop grown in a contaminated lowland rice field and to compare the efficiency of the different remediation techniques in heavy metal mitigation and rice production.

Ocular survey was conducted in the vicinity of a mining area in Santa Cruz, Zambales. The basic criterion for the selection of the study site was the presence of an irrigated rice field. It was conducted in two (2) cropping seasons, soil amendments were applied at a rate of 10 t ha^{-1}. Each plot has a dimension of 4m x 5m and spaced at 0.50m from each other. All plots were separated by small bunds and canals to avoid contamination of treatments. All agronomic and soil parameters were laid out in Randomized Complete Block Design (RCBD) (Gomez and Gomez, 1984) with four replications. NSIC Rc160 (Tubigan 14) rice seed variety was used for all treatments.

Results indicate that the use of vermicast, carbonized rice hull, bagasse ash and zeolite combined with inorganic fertilizer increased grain yield and at the same time reduced the uptake of Cr and Ni in grains. Total and available Cr and Ni in the soil were markedly reduced as compared to the control. Higher yield was obtained with the addition of vermicast however, zeolite was the most effective soil amendment in mitigating total and available Cr and as well as available Ni while carbonized rice hull for total Ni in the soil. Highest return on investment was realized with the application of bagasse ash due to its cheaper/free cost while lowest ROI was observed with zeolite due to its relatively higher cost.

Keywords: soil amendments, bio-accumulation, translocation, heavy metals, toxicity