Int. J. of Sustainable Water and Environmental Systems
Volume 3, No. 1 (2011) 33-36

The study of the use of mycorrhizae, barley and common vetch in the remediation of Pb, Zn, Cd, As, Ni and Al contaminated soils on old mine sites

Aysen AKAY *, Emel KARAARSLAN

Selcuk University, Faculty of Agriculture, Dept. of Soil Science Konya-Turkey

Abstract

In the present study, the effect of mycorrhiza inoculation and barley and common vetch production on the remediation of Pb, Zn, Cd,As, Ni and Al contaminated soils on old mine sites was examined. For this purpose, two types of barley (*Hordeum vulgare*) (Karatay-94 and Larende) and a type of common vetch (*Vicia sativa*)(Tamkoc-2000) which are widely cultivated in the Konya province of Turkey, where the study was conducted, were used as test plants. Furthermore, *G.Mosseae* type mycorrhiza inoculation was also implemented on the plants. The total heavy metal contents of the soils used in the experiment were as follows: 10.000 mg Pb kg^{-1} soil, 10.000 mg Zn kg^{-1} soil, 254.7 mg Cd kg^{-1} soil, 39 mg As kg^{-1} soil, 43.7 mg Ni kg^{-1} soil and 5.84 % Al. In the study, three different soil mixtures were used as growth medium. These were 1) pure mine soil, 2) 1 unit mine soil + 2 units sand and peat mixture, 3) 2 units mine soil + 1 unit sand and peat mixture. The pots were inoculated with *Glomus mosseae* during the planting process. The growth of plants inoculated and not inoculated with mycorrhizae was observed and inoculation, root weight, stems weight and root length values were measured. At the end of the experiment it was observed that plants inoculated with *G.Mosseae* showed better growth and their root growth and stem growth were much better when compared to plants which were not inoculated with mycorrhizae. When the plants were compared, it was found that common vetch showed better growth compared to two types of barley. Heavy metal uptake levels of the plants were also determined as the result of the experiments.

Keywords: *Mycorrhizae, heavy metals, barley, common vetch, Pb, Zn, Ni, As*

1. Introduction

The role of mycorrhizae in nutrient uptake by plants is a topic of intense current interest. Mycorrhiza improves nutrient transfer from the soil to the roots of the host plant [1]. Plant – Arbuscular mycorrhizal (AM) fungi symbiosis may alter the growth of the plant host and may play an important role by increasing the stress-tolerance of the host-plant. Today, heavy metal pollution in soils has been gradually increasing. AM fungi from heavy metal-contaminated soils and associated with metal-tolerant plants may be effective in accumulating heavy metals in roots in a non-toxic form [2].When the soils contain high, potentially toxic amounts of heavy metals, mycorrhizal formation usually induces lower concentrations of these metals in the aerial part of the plant and consequently has a beneficial effect on plant growth, as it has been reported for Zn [3,4]. Observations of the absence or only low presence of mycorrhizal inoculums in mine spoils could explain the lack of mycorrhizal colonization. However, no inhibition of mycorrhizal root colonization was observed in some heavily polluted mining areas [5]. It was reported that shoot concentrations of Zn,Cu,Pb and Cd decreased with AM colonization at high levels of available metals, whereas at lower levels metal uptake increased compared with nonmycorrhizal plants [6]. Cadmium, Ni-, and Zn-transfer from soil to plant was lower in plants with mycorrhizal symbiosis. Cadmium, Ni- and Zn-tolerance of AMF can be different, depending whether the AMF originated from metal-polluted or not-polluted soils [7]. The influence of arbuscular mycorrhizae (AM) on plant growth and Zn and Pb uptake by *Lygeum spartum* and *Anthyllis cytisoides* was studied in soils with different levels of these heavy metals. The infectivity of the fungi was not affected by the presence of Zn or Pb in the soil. In unamended soil, both fungi were equally effective in promoting plant growth, but when Zn or Pb were added to soils, *G. mosseae* was more efficient than *G. macrocarpum* in stimulating plant growth of *A. Cytisoides* [8]. Although both zinc and VAM influenced the uptake and translocation of various minerals, differences in mineral concentrations could not explain why a higher biomass is produced by grasses infected with mycorrhiza in zinc-polluted soil [9]. Various authors have reported isolating spores of arbuscular mycorrhizal fungal texa such as Glomus and Gigaspora associated with most of the plants growing in heavy metal polluted habitats [10, 11]. It was isolated only *Glomus mosseae* [12] and *Glomus fasciculatum* [9] alone from the heavy metal polluted soils. It was studied the interaction between soil pH and inoculation with rhizobia and vesicular-arbuscular mycorrhizae (VAM) in an industrially polluted soil contaminated with high levels of Zn and Cd [13]. Alfalfa (*Medicago sativa* L.) was planted in each treated soil an subsequently inoculated with Rhizobium meliloti and/or a mixed VAM spore population. At the end of study, the researchers determined that at the highest soil pH (7.2) available heavy metal concentrations were generally lower and VAM significantly increased the heavy metal uptake, and the

* Aysen Akay. Tel.: +903322232907
Fax: +903322410108; E-mail: aakay@selcuk.edu.tr

DOI:10.5383/swes.03.01.006