Copper and zinc tolerance in two Montana grass species growing on copper mill tailings
by John Edward Surbrugg

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE
in Land Rehabilitation
Montana State University

Abstract:
Copper smelter operations have been in existence in Anaconda, Montana since the late 1800's. The tailings material, deposited just east of the city, is essentially devoid of vegetation. However, Deschampsia cespitosa and Aarostis tenuis grasses were found colonizing areas of the tailings. Tailings from a vegetated area were analyzed and upon examination it was determined that copper and zinc were possibly toxic to the plants. The purpose of this study was therefore to determine the tolerance of Deschampsia cespitosa and Aarostis tenuis to copper and zinc. .

A greenhouse study using a sand, drip culture apparatus was used to determine metal tolerance. Commercial seed populations of the same genus and species were used as controls. An "in parallel" technique utilizing 4 concentrations of each metal allowed regression analysis of root growth on test concentration. Statistical analysis was used to identify differences in metal tolerance between the tailings and the control populations.

Results indicated that the mill tailings population of Deschampsia cespitosa was significantly more tolerant of copper and zinc than the commercial population. Agrostis tenuis from the mill tailings was found to possess significant copper tolerance only. Commercial and mill tailings populations of Agrostis tenuis were statistically similar in their response to zinc. A stimulating effect on root growth was observed at moderately low levels of zinc in the tailings plant species. This often observed stimulus may itself be related to tolerance.

An economic and viable method for stabilizing metalliferous sites is vegetative stabilization involving naturally occurring metal tolerant species. The confirmed tolerance to zinc and copper of the grass species colonizing the copper mill tailings at Anaconda, Montana indicates these species may be suitable for use in revegetating copper and zinc contaminated sites.

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Date 6/1/82

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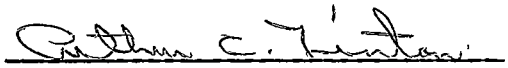
Approved:

Chairman, Graduate Committee



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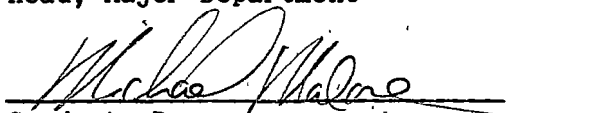

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ABSTRACT

Copper smelter operations have been in existance in Anaconda, Montana since the late 1800's. The tailings material, deposited just east of the city, is essentially devoid of vegetation. However, Deschampsia cespitosa and Agrostis tenuis grasses were found colonizing areas of the tailings. Tailings from a vegetated area were analyzed and upon examination it was determined that copper and zinc were possibly toxic to the plants. The purpose of this study was therefore to determine the tolerance of Deschampsia cespitosa and Agrostis tenuis to copper and zinc.

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Results indicated that the mill tailings population of Deschampsia cespitosa was significantly more tolerant of copper and zinc than the commercial population. Agrostis tenuis from the mill tailings was found to possess significant copper tolerance only. Commercial and mill tailings populations of Agrostis tenuis were statistically similar in their response to zinc. A stimulating effect on root growth was observed at moderately low levels of zinc in the tailings plant species. This often observed stimulus may itself be related to tolerance.

An economic and viable method for stabilizing metalliferous sites is vegetative stabilization involving naturally occurring metal tolerant species. The confirmed tolerance to zinc and copper of the grass species colonizing the copper mill tailings at Anaconda, Montana indicates these species may be suitable for use in revegetating copper and zinc contaminated sites.

INTRODUCTION

Anaconda, Montana has been the site of copper smelter operations since the late eighteen hundreds (Figure 1). Nearly 75 years of waste material from the smelting process has been deposited just east of the city of Anaconda in a tailings dump (Anaconda Copper Company 1979). The extraction process removes much of the mineral from the ore, but may leave behind as much as one percent of the primary mineral. This may be accompanied by other metals in the ore which were not worth extracting (Bradshaw 1971).

Typical reclamation techniques for tailings dumps have included regrading, veneering the surface with crushed limestone, covering the tailings with topsoil and seeding (Anaconda Copper Company 1979). This traditional revegetation effort may be adequate under some spoil physical and chemical conditions but has potential to fail under the adverse conditions of tailings dumps. Tailings characteristically have high acid-generating potential and, without continuous applications of lime, vegetation may not survive.

The European method of mine reclamation may be quite different than the modern American approach. For almost 30 years, investigators in the United Kingdom have been successfully establishing metal tolerant vegetation on metalliferous mine sites. They have found that populations of certain species growing in soils containing large amounts of heavy metals may be tolerant of the metal, and will grow

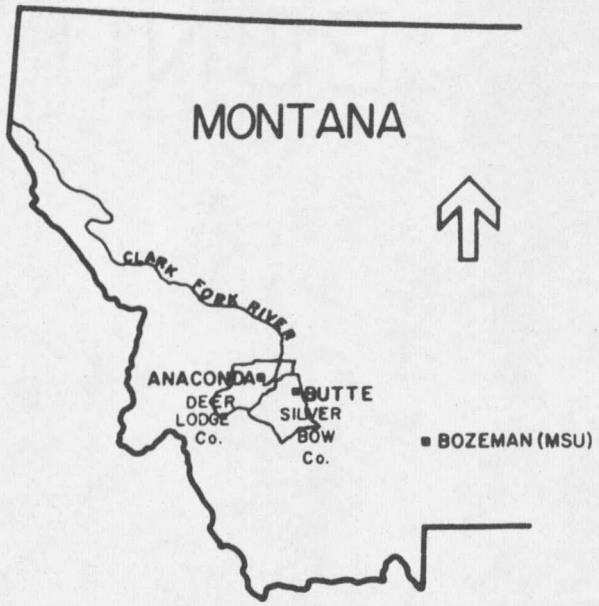

Figure 1. Location of Anaconda, Montana

better on such soils than transplants from uncontaminated soils (Bradshaw 1952).

Techniques for identifying tolerant vegetation have been developed. These techniques measure the degree to which plants will tolerate concentrations of heavy metals in solution culture (Wilkins 1957; Jowett 1958). These measurements along with field trials have produced commercial varieties of grass with specific tolerances to certain metals.

There is a great need to stabilize tailings dumps and other