Preliminary evaluation of *Equisetum hyemale* as a bioaccumulator of Aluminum Boron, Zinc, Iron, and Copper

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Abstract

Equisetum species are ancient, vascular, fern-like species, known as horsetails or scouring rushes. Due to their lack of economic importance *Equisetum* species have not been as extensively studied when compared to food and fiber crops. However, it has been demonstrated their potential to non-selectively accumulate metals and/or nutrients within their tissues and their importance in nutrient cycling. Field samples of *Equisetum hyemale* that were collected and analyzed in 2007 revealed that these plants were indeed bioaccumulators of selected elements. We have recently conducted a preliminary study of these plants from Nodaway County, Missouri under controlled conditions in the greenhouse laboratory. The analysis of *E. hyemale* aboveground tissues demonstrated that it significantly accumulated zinc (960%), iron (180%), copper (110%) and boron (2400%) in its aerial stems than was bioavailable in the soil. In addition, *E. hyemale* accumulated 1100, 350, 3800, 750, and 2300% more zinc, manganese, iron, copper and boron in its rhizome structure than was bioavailable in the soil, respectively.

Figure 1: *Equisetum hyemale*

Research Objective

♦Characterize the potential of *E. hyemale* to bioaccumulate boron (B), zinc (Zn), iron (Fe) and copper (Cu) in the aerial stems.

Figure 2: *Equisetum hyemale*

Materials and Methods

♦Aerial stems were removed from plants collected near Middlebrook, MO.

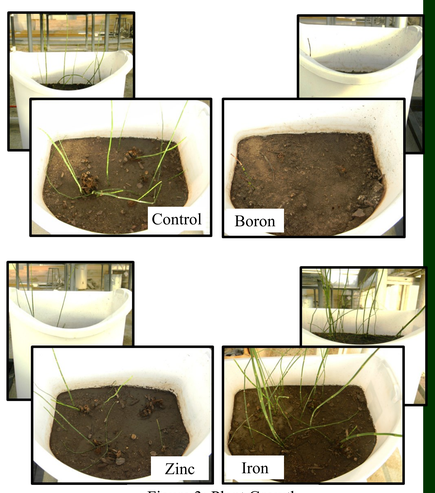

Figure 3: Plant Growth

♦Laboratory analyses of stem and soil Samples were conducted by A&L Eastern Labs, Inc: Soils—Mehlich III Extraction
Plants—Nitric Acid Extraction

♦Remaining rhizomes were washed and planted into containers of native soil.

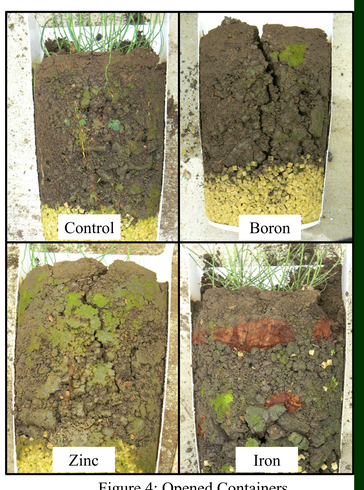

Figure 4: Opened Containers

♦ Soils included a control and those amended with 37 ppm boron, 200 ppm zinc, 1000 ppm iron, 10 ppm aluminum, and 100 ppm copper.

♦ *E. hyemale* rhizomes were allowed to grow for approximately 65 days (Fig. 3).

Figure 5: Soil Probe

Results

♦Pre-analysis suggests the bioaccumulation of elements in their aerial tissues.

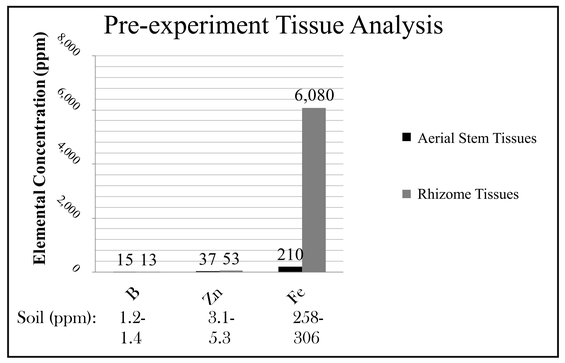

Figure 6: Pre-experimental analysis of plant tissues.

♦ *E. hyemale* grown in amended soils contained higher concentrations of elements in aerial stems than plants grown in native soils.

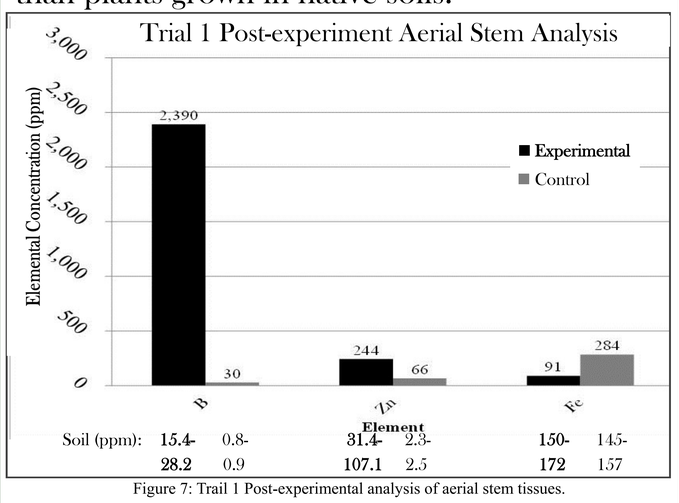

Figure 7: Trail 1 Post-experimental analysis of aerial stem tissues.

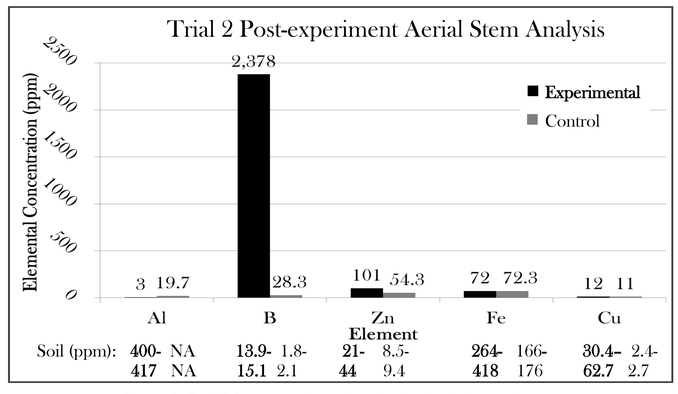

Figure 8: Trail 2 Post-experimental analysis of aerial stem tissues.

Discussion

♦Data suggests bioaccumulation of B and Zn in the aerial tissues. However, Fe, Zn, Al, and Cu do not appear to be accumulated in high levels.

♦Soil plant available boron exceeded the toxicity level and prevented well developed growth.

Figure 9: Most Recent Trial

♦The results of the previous trial were ***confirmed*** in this experiment.

♦Further studies should be conducted by planting in a pearlite mixture to further eliminate any soil contamination.

Acknowledgements

♦A&L Eastern Laboratories, Inc.

♦Marsh, A. S., Arnone, J. A., III, Bormann, B. T., and Gordon, G. C. 2000. The role of Equisetum in nutrient cycling in an Alaskan shrub wetland. Journal of Ecology 88:999-1011.

♦Figures 1&2: http://freeimagefinder.com detail/5947687683.html.

♦Aaron Sickle, Ph.D.

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