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POTENTIAL OF TALL FESCUE GRASSES FOR PHYTOREMEDIATION OF LEAD-ZINC CONTAMINATED SOILS: A PERSPECTRIVE FROM A GREENHOUSE EXPERIMENT ON GROWTHS OF FESCUE TALL GRASSES

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"Kentucky-31" tall fescue grass (Festuca arundinacea Shreber) can be found growing abundantly in regions of temperate climate in Asia, Australia, Europe, North America, and South America, is widely known to cause fescue toxicosis to cattle grazing on the fescue pastureland. The fescue toxicosis to cattle has been traced to the presence of endophytes, Neotyphodium coenophialum, a type of fungi that live entirely within the tissue spaces of above ground parts of the grass plants and have been known to produce ergot alkaloids that are the main causes for the cattle toxicosis. Until now the nutrient uptake by such endophyte infected grasses has received investigations that have focused just about only on major nutrient elements, with the total omission of Si, in above ground parts of the grasses, as the endophytes live in the above ground parts of the grasses. Our preliminary study includes both the above ground and the below ground parts of the grasses and makes a comparison in the nutrient uptake between an endophyte infected tall fescue grass (E+) and its apparent correlative that is nearly endophyte-free (E-), based on their growth on a vermiculite-rich soil substrate in a laboratory controlled greenhouse environment. The NDVI-image, relating to the photosynthetic activity, had shown that the E+ grasses are nearly 30% more efficient in photosynthesis activity. The dry ash contents appeared to be 77mg/gm for the E+ grass with the above ground parts containing being nearly 2.8 times enriched in specific mass than the roots, whereas about 66mg/gm for the E- grass with the above ground parts being about 3.7 times more enriched in specific mass than the below ground parts. The roots of endophyte-infected grasses had considerably higher K, Mg, Mn, Fe, and Ca, P, Si, and Al contents, the values ranging from 40% to as high 350%, with all the elements having less than 70% higher, except for the Fe and Mn having had 350% and 215% respectively, higher than the roots of the endophyte-free grasses. Considering the minor and trace element contents of the grasses, the roots of endophyte-infected grasses contained 31.3 ppm Zn, 0.6 ppm Pb, and 0.7 ppm total REE, whereas the roots of endophyte-free grasses contained 17 ppm Zn, 0.5 ppm Pb, and 0.5 ppm total REE. The shoots of both grasses had higher Zn contents than their corresponding roots, but lower Pb contents than the corresponding roots, the E+ shoots with 102 ppm Zn and 0.5 ppm Pb and the E- shoots with about 55 ppm Zn and 0.25 ppm. The endophyte-infected grasses apparently accomodated 135 ppm Zn and 1.1 ppm Pb. Because of their rapid growth, these grasses could be sought for remediation of Zn and Pb from contaminated soils. The relatively high Si contents for the endophyte infected grasses may be related to increased resistance to fungal diseases or higher mechanical stability of the plant tissues allowing the plants to have improved light interception. The REE distribution pattern of shoots relative to roots for E+ grasses was marked by a positive Eu anomaly, whereas that for E- grasses was marked by a negative Eu anomaly. The REE distribution patterns of shoot relative to root for both grasses otherwise were broadly very similar, both having found to be with Ce positive anomalies, with enrichments in heavy rare-earth elements, and with depletions in middle rare-earth elements. The relatively much less prominent middle rare earth element depletion for the E+ grasses probably reflects less P rejection in their root zone.