Geophysical Research Abstracts
Vol. 18, EGU2016-13478-3, 2016
EGU General Assembly 2016

The effectiveness of surface liming in ameliorating the phytotoxic effects of soil contaminated by copper acid leach pad solution in an arid ecosystem

Peter Golos (1,2)

(1) The University of Western Australia, School of Plant Biology, Perth, Western Australia, (2) Kings Park and Botanic Garden, Perth, Western Australia.

Revegetation of sites following soil contamination can be challenging especially in identifying the most effective method for ameliorating phytotoxic effects in arid ecosystems. This study at a copper mine in the Great Sandy Desert of Western Australia investigated vegetation restoration of a site contaminated by acid (H_2SO_4) leach pad solution. Elevated soil copper at low soil pH is phytotoxic to plant roots inhibiting root elongation. In arid ecosystems where rapid root growth is crucial for seedling survival post germination physical or chemical barriers to root growth need to be identified and ameliorated. Initial attempt at rehabilitation of contaminated site with hydrated lime ($CaOH_2$) at 2 tonnes/ha followed by ripping to 30 cm depth then seeding was ineffective as successful seedling emergence was followed by over 90% seedling mortality which was 10-fold greater than seedling mortality in an uncontaminated reference site. High mortality was attributed to seedling roots being impededed as soil water was more than 3-fold greater at 5 to 40 cm depth in contaminated site than reference site. In response to high seedling mortality after emergence test pits were dug to 1 m deep to collect soil samples at 10 cm intervals for phytotoxicity testing and to measure soil pH-$CaCl_2$, copper (DPTA ion extraction), electrical conductivity and gravimetric water content in three replicate pits at three replicate sites. Also, soil impedance was measured down the soil profile at 5 cm intervals at six replicate points/pit. For phytotoxicity testing soil samples were placed into three replicate plastic pots/sample and seeded with 10 seeds of *Avena sativa* and watered daily. Seedlings were harvested after at least two weeks after seedling emergence and rooting depth in pots measured.

There was no difference in seedling emergence and survival of seedlings between contaminated and uncontaminated soil samples however mean seedling root growth was significantly lower in soil samples collected at >10 cm depth than the control. Mean soil pH at 0-10 cm was higher (>7.2) at all sites treated with lime compared to uncontaminated soil (5.5). At depths greater than 10 cm soil pH was <4.6. Soil copper was >16 mg/kg in all contaminated soil samples compared to 0.5 mg/kg in control. High seedling mortality in contaminated site is attributed to low soil pH and elevated soil copper levels which inhibited plant root growth and hence access to soil water. While surface liming of soil increased soil pH ameliorating the effect of elevated soil copper, this was only effective in the top 10 cm due to low solubility of hydrated lime. To improve seedling survival lime will need to be incorporated into the contaminated soil profile to allow plants to access soil water at depth.

This study highlights the importance of the need to assess the phytotoxic effects of soil contamination and the effectiveness of amelioration treatments and with proper reference to its ecological context. To improve the success of vegetation restoration of sites contaminated with acidic copper solution, lime needs to be incorporated into the contaminated soil profile to allow plant roots to access soil water at depth. This study highlights the importance of the need to assess the phytotoxic effects of soil contamination and the effectiveness of amelioration treatments and with proper reference to its ecological context.