Supramolecular Chemosensing Materials as Soil Copper Test Kits

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Copper is a vital nutrient for plants, however high concentrations may be detrimental to plant health causing a significant reduction in seed germination, growth and in extreme cases, plant death. Copper may accumulate through addition of sewage sludge, pig manure, mine slag, or more commonly through copper containing fungicides and fertilisers. Therefore continual monitoring of copper concentrations may be vital to maintaining heathy soils in these environments. However current analysis techniques are often out of reach of local landholders and members of the community. As they require expensive laboratory based instrumentation such as atomic absorption spectroscopy or inductive coupled plasma – mass spectrometry. Hence the development of a portable inexpensive 'test kit' with a simple and fast procedure for soil testing is required.

Supramolecular chemosensors have shown potential as materials for highly selective recognition of metal ion and/or anion species through a visible and/or fluorescent colorimetric response. It has been the purpose of this work to develop a new chemosensor with a selective response to copper ions. Based off salicylaldehyde and naphthalene molecular units, this chemosensor expresses colorimetric detection for copper ions via a colourless to yellow colour shift in copper containing solutions. To detect exchangeable copper in soils, standard approaches using ammonium chloride (1:10 w/v 1M NH_4Cl) or calcium chloride (1:10 w/v 0.1M $CaCl$) were used. Addition of a methanol solution containing the chemosensor to the supernatant produces a positive response for copper. When used in conjunction with ultraviolet–visible spectroscopy (UV-Vis) and Beer's law the detection for copper can be used for quantitative measurements.

The chemosensor presented in this research may be easily adapted as a cheap and effective field technique for qualitative (basic colour change) and quantitative (field portable UV-Vis) detection of copper in soils. Furthermore, these 'test kits' may empower local landholders and members of the community to undertake rapid assessments of metal ion detection in their own soils without the need of equipment intensive methods.