Evaluating P sustainability using biosolids in comparison to commercial fertilizer for P-use efficient genetically transformed lettuce

Neng Iong Chan, Bruce Rittmann, and James Elser
Arizona State University, College of Liberal Arts and Sciences, School of Life Sciences, Tempe, United States of America (nengiong.chan@asu.edu)

The sustainable management of phosphorus (P) includes recycling and enhancing P-use efficiency (PUE) in agriculture. In this study, we compared plant yield and the PUE of lettuce growing with soil amendments of biosolids from three wastewater treatment plants in comparison to commercial fertilizer. Furthermore, we used AVP1-transformed lettuce (Lactuca sativa cv. Conquistador), which is genetically improved to enhance its PUE, and compared its performance to non-transformed (wildtype, WT) lettuce in greenhouse conditions. AVP1 lettuce produced higher yield than WT lettuce only with commercial-fertilizer treatments; the yield with biosolid treatments did not vary between the two lettuce types. PUE did not differ between WT and AVP1 lettuce but was higher for commercial fertilizer than for biosolids. WT lettuce had higher P content in below-ground biomass than AVP1 lettuce when both were treated with biosolids. This suggests that capability of AVP1 lettuce to acidify the root zone may have mobilized heavy metals from biosolids and these toxins reduced the yield, P uptake, and PUE in AVP1 lettuce. In particular, Cd and As contents were high in lettuce biomass from biosolid treatments and exceeded recommendations for human daily oral dose.