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Vermicompost-assisted phytoremediation of toxic trace element-contaminated soil in Madaka, Nigeria, using *Melissa officinalis* L and *Sida acuta*

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Abstract

The aim of this study was to clean up toxic element polluted soil in Madaka, Niger State, Nigeria. Standard techniques were used to determine the soil physicochemical properties. To aid the plants (*Melissa officinalis* L and *Sida acuta*) during the remediation process, standard methods were used to make chicken dropping vermicompost and goat manure vermicompost. *M.*

officinalis L mopped up toxic elements in the first location (Angwan Kawo), with concentrations of cadmium, arsenic, and lead ranging from 0.007 to 0.33 mg/kg, 0.09 to 4.39 mg/kg, and 0.07 to 10.35 mg/kg, respectively, while toxic elements, cadmium, arsenic, and lead in *S. acuta*, ranged from 0.002 to 0.43 mg/kg, 0.27 to 3.79 mg/kg, and 1.68 to 10.7 mg/kg, respectively. The two plants mopped up toxic elements at different rates in the second location of the polluted soil (Angwan Magiro). Cadmium, arsenic, and lead concentrations in *M. officinalis* L ranged from 0.03 to 0.41 mg/kg, 0.65 to 4.65 mg/kg, and 1.93 to 11.49 mg/kg, respectively, while toxic element concentrations in *S. acuta* ranged from 0.06 to 0.66 mg/kg, 0.68 to 4.64 mg/kg, and 1.53 to 11.53 mg/kg, respectively. *Melissa officinalis* L and *Sida acuta* were found to be the most suitable plants for phytoextraction of toxic element-contaminated sites because their bioconcentration factor, translocation factor, and biological accumulation coefficient were all greater than one (> 1), and both plants had bioconcentration and translocation factor < 1 ; they were also classified as phytostabilizers. As a result, the plants could be used to clean up Madaka soil polluted with toxic element.

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Availability of data and materials

Data are available on request from the authors. The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Contributions

This work was carried out in collaboration with all authors. Author S.A. Aransiola anchored the field study, gathered the initial data, performed the preliminary data analysis, and designed the study. U.J.J. Ijah wrote the protocol and interpreted the data. Author O.P. Abioye and J.D. Bala managed the literature searches and produced the initial draft. All authors read and approved the final manuscript.

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Ethics declarations

Conflict of interest

The authors declare that there is no conflict of interest.

Ethical Approval

Not applicable.

Consent to Participate

Not applicable.

Consent to Publish

All authors have approved the manuscript and agree with its submission to this journal.

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