A new nickel hyper-accumulator in the Asteraceae on serpentinite in the Barberton Greenstone Belt, South Africa

Stefan Siebert¹, Nishanta Rajakaruna¹,², Nadine Schutte¹, Dennis Komape¹ and Pieter Bester¹,³

¹School of Biological Sciences, Unit for Environmental Sciences and Management, North-West University, Potchefstroom, South Africa
²Biological Sciences Department, California Polytechnic State University, San Luis Obispo, United States of America
³Pretoria National Herbarium, South African National Biodiversity Institute, Pretoria, South Africa

nadineschutte2@gmail.com

Abstract
Collections of the Asteraceae were made from serpentinites in the Barberton Greenstone Belt (BGB) of South Africa to test for hyper-accumulation of nickel by members of this taxonomic group. The survey was prompted as very few nickel hyper-accumulators are known from South Africa, despite the large diversity of Asteraceae associated with the BGB. A previous study of the Asteraceae occurring on serpentinites of the BGB revealed five of the 56 taxa tested to be hyper-accumulators of nickel. Considering the phytoremediation applications of the known South African hyper-accumulators, such as Berkheya coddii, further exploration is required to search for more species with this ability. This study targeted the most frequently occurring Asteraceae taxa on eight randomly selected serpentinite outcrops in the Barberton-Kaapsehoop region, namely four outcrops in grassland at an altitude above 1200 m and four in savanna below 800 m. Twenty species were sampled, including 12 that were tested for nickel hyper-accumulation for the first time. Although the majority of the species were excluders, a few species did accumulate nickel in the leaves as would be expected for known hyper-accumulators such as Berkheya nivea and B. zeyheri subsp. rehmannii var. rogersiana (Arctoteae). A new hyper-accumulator of nickel was identified. Senecio conrathii accumulated nickel in its leaves at 1017±382 µg/g (n = 5) on soil with a nickel content of 1917 mg/kg. This is the third species in the Senecioneae of South Africa to hyper-accumulate nickel after Senecio anomalochrous and S. coronatus. Seven tribes in the Asteraceae were screened and once again the only nickel hyper accumulators were recorded from the Arctoteae and Senecioneae. This suggests that further exploration for hyper-accumulators should focus on these tribes as they contain the six species (of 68 Asteraceae taxa from the BGB tested) to hyper-accumulate nickel.
A New Nickel Hyperaccumulator in the Asteraceae on Serpentinite of the Barberton Greenstone Belt, South Africa

Stefan J. Siebert1, Nishanta Rajakaruna2,3, Nadine Schutte1, Ricard B. Boneschans1, Dennis M. Komape4 and Stoffel P. Bester1,3
1Unit for Environmental Sciences and Management, North-West University, Private Bag X6001, Potchefstroom, 2520, South Africa
2Biological Sciences Department, California Polytechnic State University, San Luis Obispo, United States of America
3National Herbarium, South African National Biodiversity Institute, Pretoria, South Africa

Introduction

Plants occasionally accumulate nickel (Ni) when they occur in environments where this metal is in abundance and available for plant uptake. However, most plants will exclude this metal and it is generally on Ni-rich soils associated with serpentinite where the ability to hyperaccumulate Ni has evolved numerous times world-wide. The serpentinites of Barberton Greenstone Belt in South Africa are no exception (Morrer et al. 1989; Hughes & Noble 1991).

Five nickel hyperaccumulators belonging to the Asteraceae have been previously recorded for serpentine outcrops in South Africa. The phytoremediation applications of the known hyperaccumulators (Ellery & Walker 1986), such as the indigenous Berkheya coddii, necessitate further exploration for species with this ability. This study targeted the most frequently occurring species of the Asteraceae on eight randomly selected serpentine outcrops of the Barberton Greenstone Belt.

The aim of this study was to screen species in the Asteraceae found on serpentinite for their ability to hyperaccumulate Ni.

Materials and Methods

Eight serpentinite outcrops were randomly chosen for this study (Fig. 1). At each outcrop 2-3 frequently occurring Asteraceae were sampled. Twenty species were sampled, which included excluders (r < 1793 pg.g⁻¹) and hyperaccumulators (r ≥ 1793 pg.g⁻¹), a known hyper-accumulator (Smith 1989; Hughes & Noble 1991).

A third species, Senecio conrathii (Fig. 2), also hyperaccumulated Ni, but has not previously been documented as having such capabilities.

Conclusions

• Senecio conrathii is a hyperaccumulator of nickel.
• Ni in plant tissue of screened hyperaccumulators increases as the amount of water soluble Ni in the soil increases.

References