SHORT COMMUNICATION

Copper and cobalt in African species of Aeolanthus Mart. (Plectranthinae, Labiatae)

Summary

Hyperaccumulators (here defined as species containing at least 500 μg/g dry weight of either copper or cobalt in leaves), are of interest for the fields of mineral exploration and phytochemistry. Reported hyperaccumulation of copper in Aeolanthus biformifolius and the presence of two other species on copper/cobalt mineralization in Shaba (Zaire) led to a survey of these elements in 49 species of the African genus Aeolanthus Mart. A. biformifolius appears to be also a hyperaccumulator of Co (2520 μg/g in leaves, 4300 μg/g in corms). Cobalt levels for most species of Aeolanthus were considerably above typical values for phanerogams and indicate the favorable potential of the genus for further study.

Introduction

Although there are many examples of remarkably high uptake of certain heavy metals by vegetation (e.g. nickel and zinc, considerably fewer instances have been recorded for copper and cobalt. In Shaba Province (formerly Katanga), Zaire, however, extensive copper/cobalt mineralization exists in the so-called 'Shaban Copper Belt' and several geobotanical and biogeochemical studies have been carried out in this area.

These studies have shown that the genus Haumaniastrum is perhaps the most favourable for geobotanical prospecting for copper in Central Shaba. The genus includes two 'copper flowers': H. hatangense in the Lubumbashi area and H. robertii in the vicinity of Kolwezi. These species have been classified as 'polycuprophytes'. A cobalt flower, Crotalaria cobalticola, has also been reported.

A study of almost the whole genus Haumaniastrum has revealed the existence of a third cuprophyte, H. homblei. This study showed that although H. robertii has the reputation of being a copper indicator, it contains up to 1.02% (dry weight) of cobalt, far exceeding the maximum value of 0.43% obtained for copper. Its distribution may therefore be controlled by cobalt rather than by copper.

Brooks et al. have suggested the term hyperaccumulator to describe plants containing > 1000 μg/g of nickel (dry weight basis). Such plants are relatively few in number and their nickel concentrations exceed by a factor of 20, the highest values found in 'normal' plants even when growing in nickeliferous
substrates. Using this 20-fold factor as a criterion, hyperaccumulators of cobalt and copper may be defined as species containing over 500 µg/g of either element. Such plants are of twofold interest: they may be of significance for geobotanical or biogeochemical prospecting, and they are interesting subjects for phytochemical studies because of the interesting problems posed by such high concentrations of elements normally toxic to vegetation.

The literature at present records eleven hyperaccumulators of copper (nine of which are from the Copper Belt) and ten of cobalt (eight from the Copper Belt).

The discovery of a new hyperaccumulator of copper, *Aeolanthus biformalfolius*, led to a literature survey of this genus. Although two other species have been recorded over copper-rich rocks, no data are available for cobalt or copper contents other than those already reported for *A. biformalfolius*. This led us to a survey of the concentrations of these two elements in most of the species of the genus Aeolanthus in order to attempt to discover taxa of significance for mineral exploration and phytochemical studies.

**Analytical procedures**

Washed and dried leaf samples with an average weight of about 0.03 g, (about 1 cm²) were placed in 5 cm³ borosilicate test-tubes and ignited at 500°C in a muffle furnace. The ash in each tube was then dissolved in 1 cm³ of 2 M hydrochloric acid. The solutions were analysed for copper and cobalt by atomic absorption spectrophotometry. Corrections for non-atomic absorption were made by using a hydrogen continuum lamp. All concentration data were expressed as µg/g on a dry-weight basis.

**Results and discussion**

A survey of copper and cobalt concentrations in leaves of herbarium specimens of 49 African species of *Aeolanthus* supplied by the herbarium of the Jardin Botanique National de Belgique at Brussels (BR) was carried out. The results of this survey are shown in Table 1. The most striking feature of this table is the high concentrations of cobalt and copper (2520 and 432 µg/g) in *A. biformalfolius*. A high concentration of cobalt was also found in *A. saxatilis* (428 µg/g) and to a lesser degree in *A. rosulfolius* (20 µg/g). Analysis of herbarium material carries the risk of contamination problems since the samples are seldom washed before mounting. However, analysis of fresh material of the above 3 species (collected *in situ* by F.M.) afforded essentially the same high concentrations. Moreover, contamination by soil is revealed as a reddish insoluble sediment in ashed herbarium leaves and such samples were rejected in the course of our survey.

*A. biformalfolius* is clearly a hyperaccumulator to be ranked along with *Hauanaiastrum robertii*. *A. biformalfolius* was originally classified as *Icomum biformalfolium* and is moreover superficially similar morphologically to *A. rosulfolius*. It is possible therefore, that some taxa quoted in Table 1 may disappear or change their status when the genera Aeolanthus and Icomum are revised.