Different characteristics of root mucilage in aluminium adsorption between

Melastoma malabathricum & *Zea mays*

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Root mucilage consists mainly of acidic polysaccharides. One of the suggested roles of mucilage in the rhizosphere is detoxification (immobilisation) of toxic metal cations (e.g. Al) by its carboxyl group. However, we found that the roots of ***Melastoma malabathricum***, an Al accumulating plant, exuded large amounts of mucilage under Al deficient conditions, and the removal of mucilage significantly reduces Al uptake in this species. In the present study, therefore, we characterized mucilage of *M. malabathricum* and examined its role in Al hyperaccumulation. *Zea mays*, a non-Al-accumulating plant, was used as a control plant.

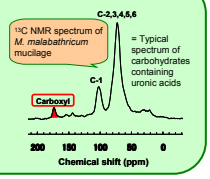


Table. Summary of characteristics of mucilages in *Melastoma malabathricum* and *Zea mays*.

	Melastoma malabathricum (Al accumulator)	vs.	*Zea mays* (Al non-accumulator)
Mucilage amount	**Large**		**Small**
Selectivity for the adsorption of cation (Fig. 1)	**Trivalent**		**Divalent**
Al form in mucilage	**Monomeric Al (very loosely fixed)** (Fig. 3)		**Tightly fixed** (Li et al., 2000)
Major component sugars	**Glucuronic acid > Galactose > Xylose (42%) (36%) (11%)**		**Galactose > Glucuronic acid > Fucose (36%) (29%) (15%)**
Total sugar (mmol L^{-1} mucilage)	**4.8**		**3.6**
Degree of methylation (%)	**7.3**		**1.9**
Charge density (meq mL^{-1}) (Fig. 2)	**1.9**		**1.0**

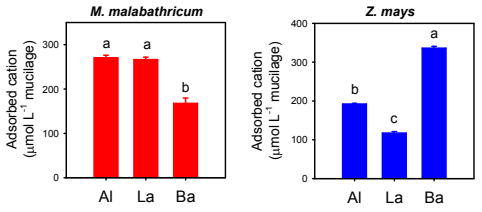


Fig. 1. Concentration of cations adsorbed on the mucilages incubated in the mixed cation solution (Al+La+Ba, 0.1 mM each, pH4.2; mucilage : solution = 1 : 4).

Mucilage of *M. malabathricum* adsorbed more Al and La (trivalent cation) than Ba (divalent cation). By contrast, mucilage of *Z. mays* adsorbed more Ba.

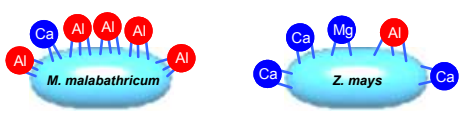


Fig. 2. Cation adsorption of mucilages.

The charge density, derived from unmethylated uronic acid, in the mucilage of *M. malabathricum* is nearly twice as high as that of *Z. mays*. This high charge density in the mucilage of *M. malabathricum* is probably the primary factor for the specific adsorption of trivalent cation.

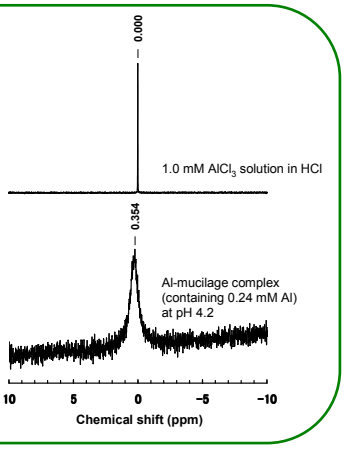
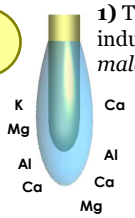


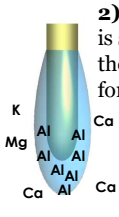
Fig. 3. ^{27}Al NMR spectra of a 1.0 mM Al solution (above) and a 0.24 mM Al solution containing mucilage of *M. malabathricum* (below).

The major part of Al adsorbed on the mucilage (ca. 80%) is visible in ^{27}Al NMR at a small chemical shift value, indicating that Al is reversibly adsorbed on negatively charged mucilage as a form of inorganic and monomeric Al with very weak interactions.

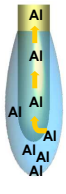
In conclusion,



1) The mucilage exudation from roots is induced under low Al conditions in *M. malabathricum*



2) A trace of Al in the medium is selectively concentrated in the mucilage as a bioavailable form



3) Concentrated Al in the mucilage is absorbed by roots

Reference

Li XF, Ma JF, Hiradate S & Matsumoto H. 2000. *Physiol. Plant.*, **108**, 152-160