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Aluminium avoidance by *Mucuna pruriens*

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The hypothesis was tested that the avoidance of acid subsoil by the velvet bean *Mucuna pruriens* is based on a mechanism acting on the whole root system rather than on individual roots. In a split-root experiment with circulating nutrient solution the growth of plants with Al-containing (+/+) or Al-free (0/0) solution on both sides of the root system was compared with that of plants which had a choice (0/+). Two levels of Al (110 and 185 μ*M*) were tested at two levels of Ca (50 and 1 250 μ*M*). In the 185 μ*M* Al treatment the concentration of monomeric Al varied between 53 μ*M*, directly after refreshing the solution, and 5 μ*M* at harvest time.

An external Al concentration of 110 μ*M* had no effect on shoot and root dry weight, while 185 μ*M* Al applied to both sides of the root system (+/+) increased root dry weight and reduced shoot dry weight and shoot/root ratio, compared with the 0/0 control. Application of 185 μ*M* Al to half of the roots, led to a significant shift in root growth in favour of the control side; this response is described here as Al avoidance. On the basis of total root length, root dry weight and root surface area, the ratio of 0/+ roots was 3.1, 2.8 and 2.4, respectively.

Al avoidance at 185 μ*M* Al was confirmed in another experiment, in which root response was measured to a local P source, supplied in a third compartment containing only KH_2PO_4. A significant increase in root length and dry weight in this compartment was observed, when other roots of the same plant were growing in the presence of Al. This result indicates that Al avoidance by *Mucuna* roots is related to P preference.

Key words – Aluminium, calcium, *Mucuna pruriens* var. *utilis*, phosphate, root growth, split-root experiment, tolerance mechanism, velvet bean.

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Introduction

In general the primary symptom of Al toxicity is stunted root growth, normally followed by reduced shoot growth. In a number of plants, however, Al reduces growth of the shoot without effects on the roots (Balsberg Påhlsson 1990). The inhibiting effect of Al on root elongation and cell division can be overcome by a range of physiological tolerance mechanisms (Clarkson 1969, Foy et al. 1978, Wissemeier et al. 1987, Klotz and Horst 1988). Relatively low concentrations of Al may even stimulate root and/or shoot growth (Hacket 1962, Van Hai et al. 1989, Hairiah et al. 1990). Both stimulation and reduction of root growth are explained by a model of Bennet and Breen (1991), who focus on the root cap as an Al sensor and on subsequent hormonal signal transduction to the meristem, without feedback from other parts of the plant.

There is a large discrepancy between results of experiments on Al tolerance in the laboratory and in the field (Horst et al. 1990). Several explanations have been given for this gap. The complex nature of Al chemistry makes it difficult to relate toxic Al concentration of solution culture studies to concentrations found toxic in soils. Even the relative ranking of tolerance between cultivars may differ between solution culture and field studies. Tolerance mechanisms based on a local modification of the environment of the root tip (e.g. by

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