The impact of arbuscular mycorrhizal fungi on radiocaesium uptake by plants

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Uptake of radiocaesium (Cs) by plants

Caesium is chemically similar to potassium (K). Root uptake mechanisms cannot differentiate between these elements easily [7].

Several types of K transport proteins contribute to Cs uptake by roots (Fig. 1) and the complement of these differs between K-replete and K-starved plants [3].

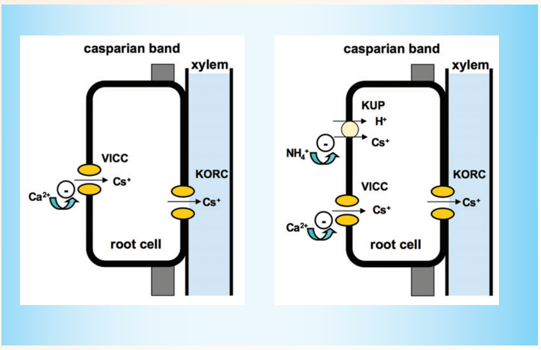

Figure 1. Uptake and transport of Cs by root cells under (A) K-replete and (B) K-starved conditions. VICC (voltage-insensitive cation channels); KUP (high-affinity K/H symporters); KORC (outward-rectifying K channels)

Cs/K selectivity

In K-replete plants, when VICC contribute most to Cs uptake, the quotient for uptake is greatest (Fig. 2).

In K-starved plants, as the expression of KUP increases, uptake of both Cs and K increases, but the Cs/K quotient for uptake decreases.

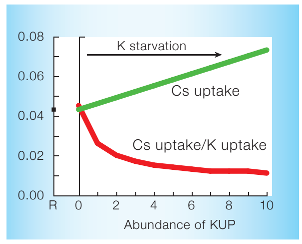

Figure 2. Predicted changes in Cs uptake (green) and Cs/K quotient for uptake (red) during K starvation when the abundance of KUP is increased, whilst the abundance of VICC remains constant. R (K-replete plants)

Influence of mycorrhiza

Over 80% of vascular plants form symbioses with arbuscular mycorrhizal (AM) fungi.

There is no consensus on the effect of mycorrhiza on Cs accumulation by plants (Table 1).

AM fungi could influence the uptake of Cs by plants by altering the expression of plant genes encoding VICC and KUP.

Reference	Influence	Plant species	Fungal species
Berrek and Haselwandter (2001)	decrease	*Agrostis tenius*	*Glomus mosseae*
Dighton and Terry (1996)	decrease	*Calluna vulgaris*	Soil fungi
Dighton and Terry (1996)	decrease	*Trifolium repens*	Soil fungi
Rogers and Williams (1986)	increase	*Melilotus officinalis*	*Glomus* sp.
Rosén et al. (2005)	increase	*Allium porrum*	Soil fungi
Joner *et al.* (2004)	no effect	*Trifolium subterraneum*	*Glomus mosseae*
Joner *et al.* (2004)	no effect	*Zea mays*	*Glomus intraradices*
Joner *et al.* (2004)	no effect	*Medicago truncatula*	*Glomus intraradices*

Table 1. Selected examples illustrating the effects of mycorrhiza on Cs accumulation by plant species.

Hypothesis

If mycorrhizae improve plant K status, then the uptake of Cs by mycorrhizal roots would occur mainly through VICC and AM fungi would decrease the accumulation of Cs by reducing the abundance of KUP in plants.

Future work

Medicago truncatula is being grown alone and in association with *Glomus sp* (Fig. 3) to test the hypothesis that Cs accumulation is decreased in mycorrhizal plants.

To investigate differences in plant gene expression in non mycorrhizal and mycorrhizal plants the Affymetrix GeneChip® Medicago Genome Array is being used.

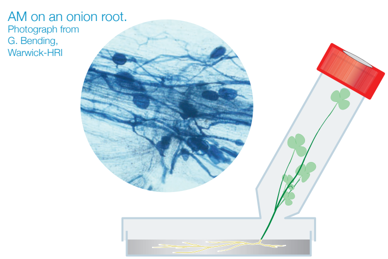

Figure 3. *In vitro* system used to grow *Medicago truncatula* in symbiosis with *Glomus sp.*

References
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