Research on Element-accumulating Capacity of Plants

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Abstract

Phytoremediation is a possible countermeasure against soil contamination with radionuclides. Identifying and establishing accumulators are the key to developing practical phytoremediation methods. This study aims to select or develop accumulators usable for radionuclides that could potentially be released in Aomori Prefecture due to location of the nuclear fuel reprocessing facility there. For that purpose, we focused on the following two approaches: to search for accumulators for Cs, Sr and I from crops and wild plants, and to employ a genetic approach to develop transgenic plants using genes controlling Cs resistance in *Arabidopsis* mutants.

The candidate accumulators of crops, *Amaranthus hypochondriacus*, *Helianthus annuus*, *Lactuca sativa* and *Portulaca oleracea* were selected from crops in FY 2008 based on their removal capacity of the target elements from soil. They were cultivated in an experimental field to conduct a reproducibility experiment in FY 2009 and *Amaranthus retroflexus* and *Persicaria lapathifolia* were selected as the candidate Cs, Sr and I accumulators of wild plants. In FY 2010, the candidate accumulators of wild plants were cultivated again in an experimental field for confirming reproducibility of the results, and their suitable planting density was determined in the field.

The finally selected Cs accumulators were *Amaranthus hypochondriacus*, *Amaranthus retroflexus*, *Helianthus annuus* and *Lactuca sativa*. *Amaranthus hypochondriacus*, *Amaranthus retroflexus*, *Helianthus annuus* and *Persicaria lapathifolia* were also selected as the accumulator of Sr and I. The suitable plant density of *Amaranthus retroflexus* was found as 16 plants/m^2 for Cs removal from soil, while that of *Persicaria lapathifolia* was 9 plants/m^2 and 4 plants/m^2 for removal of Cs and Sr, respectively.

We tried to overexpress *AtCNGC17*, which we previously identified as a Cs transporter gene, in *Arabidopsis* Cs-resistant mutants (CsR33 and CsR80) to try to produce Cs accumulator. The transgenic plants of CsR33 and CsR80 were produced by the gene transfection method of *AtCNGC17* in FY 2009, and their Cs uptake capacities were examined in 2010. The *Arabidopsis* transgenic plants overexpressing *AtCNGC17* did not accumulate more Cs than the control. The transgenic plants of *Nicotiana tabacum* (wild tobacco) overexpressing *AtCNGC17* were also produced, and their Cs accumulation was measured. Four out of five lines of the transgenic explant from tissue culture of leaf discs overexpressing *AtCNGC17* showed statistically higher ^{134}Cs uptake than the control.

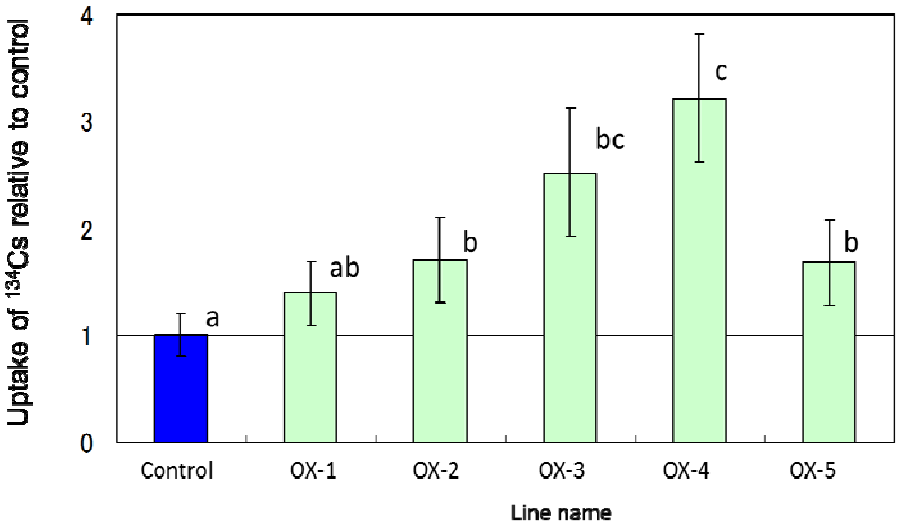

Fig. 1.Relative ^{134}Cs uptake in AtCNGC17 overexpressing tobacco plants. Error bars show ± SD (n=4). Means denoted by the same letter did not significantly differ at $p<0.05$ according to Duncan's multiple range test.