1. Title

2. Research Term
FY2002～2003

3. Research Fields
Fundamental Biology

4. Research Categories
Germinating Research

5. Research Theme
Signaling for auxin polar transport in higher plants grown under microgravity conditions

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8. Summary of Research
STS-95 space experiments have demonstrated that activities of auxin polar transport in etiolated epicotyls of pea (Pisum sativum L. cv. Alaska) seedlings grown in space were reduced as compared to those under 1 g conditions on the earth, and microgravity conditions induced automorphosis of seedlings (Ueda et al. 1999, 2000), suggesting that gravity substantially controls auxin polar transport as well as growth and development of plants. Simulated microgravity conditions on a three-dimensional clinostat have also been effective to reduce the auxin polar transport. The application of auxin polar transport inhibitors, 2,3,5-triodobenzoic acid [TIBA], N-(1-naphtyl)phthalamic acid [NPA], 9-hydroxyfluorene-9-carboxylic acid [HFCA], on etiolated pea seedlings on 1 g conditions induced automorphosis-like growth and development which was
observed under microgravity conditions in space, but that of anti-auxin, \( p \)-chlorophenoxyisobutylic acid [PCIB] did not. Strenuous efforts to learn in molecular levels how gravity affects on auxin polar transport in etiolated pea epicotyls resulted in successful separation of \( PsPIN2 \) and \( PsAUX1 \) genes of putative efflux and influx carrier proteins of auxin, respectively. Phylogenetic analyses based on the deduced amino acid sequences revealed that \( PsPIN2 \) belonged to a subclade including \( AtPIN3 \), \( AtPIN4 \) and \( AtPIN7 \), while \( PsPIN1 \) (accession no. AY222857, Chawla and DeMason, 2003) belonged to the same subclade as \( AtPIN1 \). On the other hand, \( PsAUX1 \) showed higher homology with \( AtAUX1 \) among AUXs and AUX-like proteins of various plants. Gene expression of \( PsPIN1 \) and \( PsAUX1 \) in hook region and in the 1st internode of 3.5-d-old etiolated pea seedlings grown under simulated microgravity conditions on a 3-dimensional clinostat was increased as compared with that of the seedlings grown under 1 g conditions, while that of \( PsPIN2 \) in the 1st internode was affected little. These results suggest that expression of these genes is under the control of gravity with important role in auxin movement in plant tissues. Structure and function of \( PsPIN1 \), \( PsPIN2 \) and \( PsAUX1 \) for auxin movement in etiolated pea seedlings will be investigated using \textit{in situ} hybridization techniques with antibodies of these products.

9. Publication List

Tomoki Hoshino, Reiko Hitotsubashi, Kensuke Miyamoto, Eiichi Tanimoto and Junichi Ueda


Kensuke Miyamoto, Tomoki Hoshino, Reiko Hitotsubashi, Eiichi Tanimoto and Junichi Ueda


Toru Shimazu, Kensuke Miyamoto and Junichi Ueda


Tomoki Hoshino, Reiko Hitotsubashi, Kensuke Miyamoto, Eiichi Tanimoto and Junichi Ueda

Gravistimulation changes expression of genes encoding putative carrier proteins of auxin polar transport in etiolated pea epicotyls  Adv. Space Res., 2004 to be submitted

Kensuke Miyamoto, Tomoki Hoshino, Reiko Hitotsubashi, Masamichi Yamashita and Junichi Ueda

Automorphosis of higher plants in space is simulated by using 3-dimensional clinostat or by application of chemicals  Adv. Space Res., 2004 to be submitted

10.URL