Isolation of NAC genes in green algae and Physcomitrella: origin and diversification of NAC gene family.

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The shoot apical meristem in the sporophyte (diploid) generation is an outstanding feature of vascular plants, which enables indeterminate growth to have a large body and to produce many spores or seeds. In contrast, bryophytes form only a single sporangium and do not have a shoot apical meristem that proliferate organs in the sporophyte generation. Is this because bryophytes do not have homologues to the genes required for the shoot apical meristem formation in angiosperms? Or do have these genes, but the genes are regulated to form a single sporangium? CUC1 and CUC2, which belong to the NAC gene family, are candidate genes that may have played a key role in the evolution of meristem, as they are essential for the formation of shoot apical meristem and define organ boundaries in Arabidopsis and their homologues are reported only in Angiosperms. We cloned 23 NAC genes in Physcomitrella, one gene each in Coleochaete and Closterium. Based on a phylogenetic analysis, NAC gene family originated before the split of Closterium (Zygnematales) and the land plants lineage, and diversified to at least four members in the last common ancestor of mosses and vascular plants. One of these descended to CUC1 and CUC2 in Arabidopsis and to a group of genes in Physcomitrella, which are highly similar to CUC1 and CUC2. We expect that the Physcomitrella genes function in the sporophyte development and can play the role that CUC1 and CUC2 have in the shoot apical meristem formation.