Elucidating the Role of Early Light Induced Proteins through a Cryptogam Perspective

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BACKGROUND: The human population is increasing at a dramatic rate while agricultural productivity is decreasing due to various environmental stresses such as drought or cold. Engineering plants that are more tolerant to abiotic stresses has a huge economic importance. The development of molecular technologies and omics tools has led to the identification of many candidate genes involved in stress response. Early Light Induced Protein (ELIP) is a gene that is significantly upregulated in the desiccation tolerant lycophyte Selaginella lepidophylla and moss Tortula ruralis. The role of ELIPs in seedless plants has not been well established. RESULTS: Using degenerate oligonucleotide primers, an orthologue of an ELIP was isolated from the fern Ceratopteris richardii by PCR. Using various phylogenetic analyses, it was demonstrated that ELIPs in seedless plants can be grouped into two distinct clades designated ELIPA and ELIPB. ELIPA can only be found in bryophytes and displayed significant diversification. ELIPB is structurally maintained but only in non-seeded plants. In Ceratopteris richardii, RT-PCR revealed that CrELIPB is upregulated during etiolation, ABA, and NaCl stresses. A knockdown of CrELIPB resulted in decreased germination, cell division, and chlorophyll production. Moreover, siRNA-treated gametophytes failed to develop when the light intensity was increased. CONCLUSIONS: Despite phylogenetic diversification, ELIP genes in seedless plants displayed similar mechanisms of regulation to seed plants. However, ELIPB of Ceratopteris is not dispensable to plant development possibly to due to a lack of functional redundancy or a different adaptive role. Overexpression of ELIP from cryptogams may help develop better drought-tolerant plants.