Control of plant phosphate homeostasis by SPX inositol polyphosphate sensor domains

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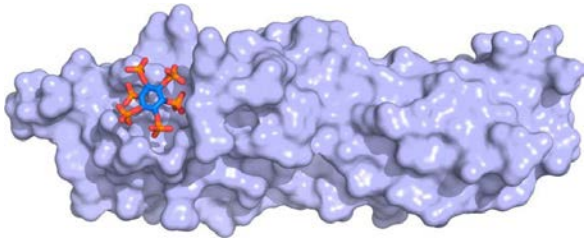
Phosphate is an important macronutrient and thus eukaryotic cells tightly regulate their intracellular phosphate (P_i) levels. P_i homeostasis can be maintained by adapting phosphate uptake, storage and transport. However, it is poorly understood how cells sense and signal their phosphate status.

SPX domains are found at the N-terminus of eukaryotic phosphate transporters, inorganic polyphosphate polymerases and signaling proteins. I will present structural, biochemical and genetic evidence that SPX domains are sensors for inositol polyphosphate (InsP) ligands, signaling molecules whose concentration change in response to phosphate availability. Mutations in the SPX InsP binding pocket impair InsP binding in biochemical binding assays, down-regulate synthesis of inorganic polyphosphate in yeast and reduce phosphate transport in Arabidopsis. Further, InPs trigger the interaction between stand-alone plant SPX proteins with a family of phosphate-starvation responsive transcription factors, thereby controlling the induction of phosphate starvation responses under low P_i. Taking together, we suggest that InsPs act as novel signaling molecules in fungi, plants and animals.

Binding of InsPs allows SPX domains to bind and regulate their downstream signaling partners and thus to regulate phosphate homeostasis in eukaryotes.



3D structure of the InsP ligand bound to the SPX sensor domain