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A *Medicago truncatula* H$^+$-pyrophosphatase gene, *MtVP1*, improves sucrose accumulation and anthocyanin biosynthesis in potato (*Solanum tuberosum* L.)

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ABSTRACT. We recently cloned *MtVP1*, a type I vacuolar-type H$^+$-translocating inorganic pyrophosphatase from *Medicago truncatula*. In the present study, we investigated the cellular location and the function of this H$^+$-PPase in *Arabidopsis* and potato (*Solanum tuberosum* L.). An *MtVP1*::enhanced green fluorescent protein fusion was constructed, which localized to the plasma membrane of onion epidermal cells. Transgenic *Arabidopsis thaliana* overexpressing *MtVP1* had more robust root systems and redder shoots than wild-type (WT) plants under conditions of cold stress. Furthermore, overexpression of *MtVP1* in potato accelerated the formation and growth of vegetative organs. The tuber buds and stem base of transgenic potatoes became redder

than those of WT plants, but flowering was delayed by approximately half a month. Interestingly, anthocyanin biosynthesis was promoted in transgenic *Arabidopsis* seedlings and potato tuber buds. The sucrose concentration of transgenic potato tubers and tuber buds was enhanced compared with that of WT plants. Furthermore, sucrose concentration in tubers was higher than that in tuber buds. Although there was no direct evidence to support Fuglsang's hypothetical model regarding the effects of H^+-PPase on sucrose phloem loading, we speculated that sucrose concentration was increased in tuber buds owing to the increased concentration in tubers. Therefore, overexpressed *MtVP1* enhanced sucrose accumulation of source organs, which might enhance sucrose transport to sink organs, thus affecting anthocyanin biosynthesis.

Key words: H^+-pyrophosphatase; *MtVP1*; Anthocyanin; Sucrose

