FLYING SAUCER1 Is a Transmembrane RING E3 Ubiquitin Ligase That Regulates the Degree of Pectin Methylesterification in Arabidopsis Seed Mucilage.

C. Voiniciuc, G.H. Dean, J.S. Griffiths, K. Kirchsteiger, Y-T. Hwang, A. Gillett,

G. Dow, T.L. Western, M. Estelle, and G.W. Haughn.

Pectins are complex polysaccharides that form the gel matrix of the primary cell wall and are abundant in the middle lamella that holds plant cells together. Their degree of methylesterification (DM) impacts wall strength and cell adhesion since unesterified pectin regions can cross-link via Ca2+ ions to form stronger gels. Here, we characterize flying saucer1 (fly1), a novel Arabidopsis thaliana seed coat mutant, which displays primary wall detachment, reduced mucilage extrusion, and increased mucilage adherence. These defects appear to result from a lower DM in mucilage and are enhanced by the addition of Ca2+ or completely rescued using alkaline Ca2+ chelators. FLY1 encodes a transmembrane protein with a RING-H2 domain that has in vitro E3 ubiquitin ligase activity. FLY1 is orthologous to TRANSMEMBRANE UBIQUITIN LIGASE1, a Golgi-localized E3 ligase involved in the quality control of membrane proteins in yeast. However, FLY1–yellow fluorescent protein (YFP) fusions are localized in punctae that are predominantly distinct from the Golgi and the trans-Golgi network/early endosome in the seed coat epidermis. Wortmannin treatment, which induces the fusion of late endosomes in plants, resulted in enlarged FLY1-YFP bodies. We propose that FLY1 regulates the DM of pectin in mucilage, potentially by recycling pectin methylesterase enzymes in the endomembrane system of seed coat epidermal cells.