β-1,4-Galactans are abundant polysaccharides in plant cell walls, which are generally found as side chains of rhamnogalacturonan I. Rhamnogalacturonan I is a major component of pectin with a backbone of alternating rhamnose and galacturonic acid residues and side chains that include α-1,5-arabinans, β-1,4-galactans, and arabinogalactans. Many enzymes are required to synthesize pectin, but few have been identified. Pectin is most abundant in primary walls of expanding cells, but β-1,4-galactan is relatively abundant in secondary walls, especially in tension wood that forms in response to mechanical stress. We investigated enzymes in glycosyltransferase family GT92, which has three members in *Arabidopsis thaliana*, which we designated GALACTAN SYNTHASE1, (GALS1), GALS2 and GALS3. Loss-of-function mutants in the corresponding genes had a decreased β-1,4-galactan content, and overexpression of GALS1 resulted in plants with 50% higher β-1,4-galactan content. The plants did not have an obvious growth phenotype. Heterologously expressed and affinity-purified GALS1 could transfer Gal residues from UDP-Gal onto β-1,4-galactopentaose. GALS1 specifically formed β-1,4-galactosyl linkages and could add successive β-1,4-galactosyl residues to the acceptor. These observations confirm the identity of the GT92 enzyme as β-1,4-galactan synthase. The identification of this enzyme could provide an important tool for engineering plants with improved bioenergy properties.