Aiming at demonstrating the potential of unidirectional natural fiber-reinforced thermoplastic composites in structural applications, textile flax yarn/thermoplastic polyester composites with variable fiber volume fractions have been manufactured by a filament-winding process followed by a vacuum-assisted compression molding process. The microstructure of the composites shows that the flax fiber yarns are well impregnated by the polyester matrix, and this supports the measured low porosity content of the composites. The experimental tensile modulus and ultimate tensile stress of the composites in the axial and transverse directions are well simulated by rule of mixtures models. In the axial direction, at a fiber volume fraction of 0.50, the experimental tensile modulus and ultimate tensile stress are 32 GPa and 350 MPa, respectively. In comparison, for glass fiber composites at a fiber volume fraction of 0.50, the tensile modulus and ultimate tensile stress are calculated to be 38 GPa and 1800 MPa, respectively. The flax yarn composites show better specific tensile modulus than the glass fiber composites with values of 23 GPa/g/cm³ and 20 GPa/g/cm³, respectively. An analysis of data from previous studies of unidirectional natural fibre composites demonstrates comparatively good reinforcement efficiency of the flax yarn fibers with an effective tensile modulus and ultimate tensile stress of the fibers in the area of 70 GPa and 800 MPa, respectively. Altogether, it is demonstrated that composites with high-quality textile flax yarn are well suited for structural applications when stiffness and weight saving are the central selection criteria.