INTISARI

Produktivitas tanaman sangat dipengaruhi oleh metabolisme sukrosa, di mana enzim *sucrose phosphate synthase* (SPS) memegang peran kunci dalam sintesis sukrosa. Pada penelitian sebelumnya, telah dilakukan rekayasa enzim SPS secara *in-vitro* dengan menghilangkan daerah N-terminal. Penelitian ini bertujuan untuk mengevaluasi pengaruh overekspresi *full-length* SPS (FL-SPS) dan ΔN-terminal SPS (ΔN-SPS) terhadap karakter agronomi serta level ekspresi gen-gen metabolisme sukrosa pada tanaman. Pada penelitian ini, tanaman sorgum (*Sorghum bicolor*) digunakan sebagai tanaman model untuk dioverekspresikan gen pengkode FL-SPS dan Δ-SPS. Penelitian dilakukan menggunakan galur (1) transgenik FL-SPS, (2) ΔN-SPS, dan (3) *wild type* (WT) sebagai kontrol. Karakter agronomi yang diamati meliputi tinggi tanaman, diameter batang, bobot basah tajuk, panjang malai, jumlah biji per tanaman, dan bobot biji. Selain itu, analisis ekspresi gen SPS, *soluble acid invertase* (SAI), dan *sucrose synthase* (SuSy) dilakukan pada empat fase pertumbuhan yaitu perkecambahan, pemanjangan batang, pembungaan, dan panen. Hasil penelitian menunjukkan bahwa overekspresi ΔN-SPS meningkatkan pertumbuhan vegetatif dan produktivitas biji secara signifikan dibandingkan FL-SPS dan WT. Galur ΔN-SPS juga menunjukkan peningkatan ekspresi gen SPS, SAI, dan SuSy terutama pada fase *seedling* dan panen dibanding FL-SPS dan WT. Penelitian ini menunjukkan bahwa pemotongan domain N-terminal pada SPS dapat meningkatkan akumulasi sukrosa dibadingkan dengan FL-SPS dan WT serta, diasumsikan dapat meningkatkan efisiensi alokasi karbon menuju pertumbuhan dan produksi biji.

Kata kunci: Sorgum, Metabolisme Sukrosa, *Sucrose Phosphate Synthase*, N-Terminal Domain, Ekspresi gen

ABSTRACT

The productivity is strongly influenced by sucrose metabolism, in which the enzyme sucrose phosphate synthase (SPS) plays a key role in sucrose synthesis. In previous studies, in vitro engineering of SPS was performed by removing the N-terminal domain. This study aimed to evaluate the effects of overexpression of full-length SPS (FL-SPS) and N-terminal-deletion SPS (ΔN-SPS) on agronomic traits and the expression levels of sucrose metabolism-related genes in plants. In this study, sorghum (Sorghum bicolor) was used as a model plant for the overexpression of genes encoding FL-SPS and ΔN-SPS. The experiment employed three plant lines: (1) FL-SPS transgenic line, (2) ΔN-SPS transgenic line, and (3) wild type (WT) as a control. The observed agronomic traits included plant height, stem diameter, fresh shoot biomass, panicle length, number of seeds per plant, and seed weight. In addition, gene expression analysis of SPS, soluble acid invertase (SAI), and sucrose synthase (SuSy) was conducted at four growth stages: seedling, stem elongation, flowering, and harvest. The results demonstrated that overexpression of ΔN-SPS significantly enhanced vegetative growth and seed productivity compared to FL-SPS and WT. The ΔN-SPS line also showed higher expression levels of SPS, SAI, and SuSy genes, particularly at the seedling and harvest stages, compared to FL-SPS and WT. This study suggests that removal of the N-terminal domain of SPS improves sucrose accumulation in leaves compared to FL-SPS and WT, as well as enhancing carbon allocation efficiency toward growth and seed production.

Keywords: *Sorghum, Sucrose Metabolism, Sucrose Phosphate Synthase, N-Terminal Domain, Gene Expression*