SEEDLING VIGOR AND CARBON DYNAMICS OF THE FIRST TRUE LEAF

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Abstract

Seedling vigor is often recognized as a desirable trait to ensure establishment of a healthy, uniform plant stand. A number of different metrics are often used to define seedling vigor and include plant size or mass measurements, early root growth, and rapid true leaf node initiation. It has also been suggested that rapid development of the first true leaf may promote early seedling vigor. Furthermore, we have demonstrated that seed lot-specific differences in early seedling vigor were associated with seed mass and macronutrient content. The current study addressed the hypothesis that seed lot specific differences in seedling vigor would be associated with early season variation in carbon dynamics of the first true leaf. The study consisted of a randomized complete block design with six cultivars selected based on differences in seed mass. At 21 and 35 days after planting (DAP) seedling vigor and crop growth characteristics were assessed via destructive measures first true leaf area, plant dry weight, whole plant leaf area, plant growth rate, and net assimilation rate. First true leaf measurements at 21 DAP included nighttime assessments of respiration rates, translocation rates, translocation efficiency, and nonstructural carbohydrate analysis and daytime assessments of net photosynthesis, actual quantum yield of photosystem II, and photosynthetic electron transport rate. At 21 DAP, when first true leaf areas were 39 to 57% of their area at 35 DAP, seedling vigor (dry weight per plant) was positively correlated with nighttime translocation rates and translocation efficiencies, whereas no correlation was observed between seedling vigor and daytime photosynthetic parameters of the first true leaf. Nighttime soluble carbohydrate content of the first true leaf was inversely correlated with seedling dry weight and leaf area, indicating that more vigorously growing seedlings translocate carbohydrate at a higher rate to developing sinks, keeping average soluble carbohydrate concentrations low in the first true leaf. This study indicates that nighttime carbon dynamics of the first true leaf may have a pronounced effect on early season plant growth and development.