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Resource competition between vascular tissue production and pod filling in soybean

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Aborted pods represent lost yield, as ovules within these pods fail to compete for resources during the reproductive stages of soybean growth. Aborted pods can reach 30% of the total pods produced, yet our understanding of underlying mechanisms of pod abortion in soybeans is poorly understood. As soybeans approach reproductive maturity, resource partitioning shifts from vegetative to reproductive sinks. In determinate cultivars, primary growth of the main stem terminates early in the seed filling stages, signaling decreasing sink strength of the shoot system and increased shuttling of photosynthate or stored resources to developing pods. However, the timing of secondary growth cessation in soybeans is unknown. Secondary growth increases the girth of the shoot system by producing additional vascular tissues (secondary xylem and phloem) from a vascular cambium. We investigated the role of secondary growth in soybean stems as a competitive sink to seed filling during reproduction in four determinate cultivars. Plants were grown in a clay-soil field site in west-central Virginia and harvested during early and late seed-filling. Vascular tissue composition was measured using two methods, first using image analysis to estimate proportionate composition of stem cross sectional area and second using analytical chemistry procedures to assess cell wall biomolecule (lignocellulose) production. While we measured limited growth of the main stem during seed filling, soybean branches showed positive growth, which we detected as up to 70% biomass increases and 28% vascular tissue production (percentage of the cross sectional area). Within the vascular tissues, lignin (but not cellulose) increased up to 5% increase during seed filling, consistent with construction of xylem secondary cell walls. Cultivars with highest increases in secondary growth within the branch system showed the greatest amounts of aborted bods, illustrating a potential trade-off between construction of vegetative tissues during late-season growth and production of full seed pods.