Current Season Photoassimilate Distribution in Sweet Cherry

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Abstract

Sweet cherry (Prunus avium) tree canopies comprise three types of leaf populations: fruiting spur (FS), nonfruiting spur (NFS), and extension shoot (ES) leaves. The contribution of each leaf population as sources of photoassimilate synthesis and distribution for sweet cherry fruit development has not been described previously. To determine how carbon fixed by different leaf populations is distributed to reproductive and vegetative sinks during fruit development, fruiting branches of 7-year-old 'Ulster' sweet cherry trees grown on 'Gisela®6' (Gi6) (Prunus cerasus × Prunus canescens) rootstock at Michigan State University's Clarksville Research Center (Clarksville, MI) were exposed to $^{13}CO2$ labeling on five dates in 2003 [25, 40, 44, 56, and 75 days after full bloom (DAFB), which occurred on 30 Apr.], comprising the period from late Stage I (SI) to late Stage III (SIII) of fruit development. Fortyeight hours after labeling, whole branches were removed and separated into different organs for ^{13}C analysis by gas chromatography–mass spectrometry (GC-MS). The organs analyzed included: FS leaves, NFS leaves, ES leaves, fruit, and wood D bark from the segment of the branch corresponding to each leaf population. Relative distribution of C from each leaf population source to each sink varied during fruit development. Overall, the proportion of ^{13}C recovered in the fruit was highest for the FS leaf population (which included fruit exposure to $^{13}CO2$), followed by the NFS leaves, then ES leaves. From SI to SIII, ≈60% of the ^{13}C recovered in the FS portion of the branch was found in the fruit, except during the exponential growth of fruit in mid-SIII (56 DAFB) when this proportion was nearly 80%. About 30% of the ^{13}C fixed by NFS leaves was found in the fruit during Stage II (SII) (40 DAFB) and early (44 DAFB) and late (75 DAFB) SIII, with higher proportions at SI (45% at 25 DAFB) and mid-SIII (70%). About 25% of the ^{13}C fixed by ES leaves was found in the fruit during SI, SII, and late SIII, with a lower proportion (17%) at early SIII when shoot growth was exponential, and a higher proportion (nearly 60%) at mid-SIII. The proportion of ^{13}C fixed and translocated to ES growth was minimal from FS and NFS leaves throughout the sampling dates, but that by the ES leaves was significant, peaking at early SIII. The results illustrate the dynamics of C contribution from each leaf population between vegetative and reproductive sinks during growth in sweet cherry orchards, which provides useful physiological information for canopy pruning and crop load regulation.