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A reduction of the plant carbon source postpones autumn leaf senescence in birch seedlings

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The length of the growing season in temperate and boreal forests has a strong effect on the global carbon balance. Yet, our current understanding of the drivers of phenological processes such as autumn leaf senescence in deciduous trees is not sufficient for making reliable estimates of future growing-season lengths under climate change. While temperature has been shown to be an important driver of autumn leaf senescence, recent evidence suggests that the concept of carbon sink limitation might help to reduce unexplained variation in leaf senescence predictions. According to the carbon sink limitation hypothesis, senescence is regulated by the balance of the plant carbon source and the plant carbon sink, so that senescence occurs later when carbon inputs (source) are low and earlier when there is a low carbon demand (sink). In our experiment, we manipulated carbon source–sink dynamics in birch seedlings (*Betula pendula* L.) to evaluate the evidence for an effect of carbon sink limitation on autumn leaf senescence in a widespread deciduous tree. Specifically, we removed leaves and/or buds from the seedlings and monitored the effects on autumn net photosynthesis and leaf senescence. In agreement with the carbon sink limitation hypothesis, we observed that a decrease in the carbon source through a high degree of leaf removal increased autumn leaf-level photosynthesis by ~14% and postponed senescence by 5.5 ± 2.4 days. Yet, we did not see significant effects of the lower- and medium-degree defoliation treatments. Further, we did not observe an effect of bud removal on either photosynthesis or senescence, which was likely caused by the fact that our bud removal treatment did not considerably change the plant carbon sink. At least partly, our results are in line with the hypothesis of carbon sink limitation as a driver of growing-season length and move the scientific field closer to narrowing a main uncertainty in climate change predictions.