Does carbon allocation determine the timing of autumn leaf senescence in deciduous trees?

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Carbon allocation is a crucial process in plants and ecosystems. However, does carbon allocation also impact plant phenology, in particular during autumn? Elucidation of autumn tree phenology is essential as autumn leaf senescence affects leaf nutrient resorption, next year tree growth potential and the seasonal exchange of energy and material (e.g. CO$_2$, H$_2$O, VOCs) between vegetation canopy and the atmosphere. Environmental manipulative experiments clearly show that the onset of leaf senescence in deciduous trees is not only controlled by internal cues but also that is crucially affected by environmental factors. Yet, we have not understood which are the environmental drivers of leaf senescence onset as, for example, day length, temperature, water and nutrient availability, all showed to impact autumn phenology in a given species, sites, years and experimental setting. The knowledge gap around the environmental drivers of leaf senescence might be due to the fact that, up to date, we have investigated autumn dynamics of leaves (carbon sources) but overlooked the autumn activity of branches, stem and roots (carbon sink). Are leaves in autumn needed for the tree if no sinks are active? In other words, is leaf senescence triggered by the cessation of tree growth in autumn? In more detailed, we expected that: (i) in the absence of growth-limiting environmental conditions, tree growth cessation directly controls leaf-senescence onset, and (ii) in the presence of growth-limiting conditions, photoperiod controls leaf-senescence onset – this prevents trees from starting to senesce too early. These hypotheses have been the topic of three years of monitoring and experimental campaigns in different deciduous species and European locations within the ERC project LEAF-FALL, and of ancillary data analysis work. The presentation aims to show key results and the most novel aspect of this line of research.