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Is bud burst of temperate trees promoted by a critical daylength?

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Bud burst of temperate trees is mainly controlled by cool temperatures during winter-dormancy (chilling), warm temperatures in spring (forcing) and daylength (photoperiod). Some tree species may rely more on one of these drivers than others (e.g. temperature driven species) but recent studies emphasize complex interactions among them for most species. As one of these factors, photoperiod can act by preventing trees from flushing too early, minimizing the risk of damaging spring frost. Yet it is unclear whether stimulating and/or inhibiting effects of photoperiod on spring phenology act (i) gradually (i.e. increasing daylength progressively accelerates bud development response to temperature) or (ii) whether photoperiod slows down bud development until reaching a critical threshold.

In this study we tested the second hypothesis by exposing twig cuttings of 5 species (Acer pseudoplatanus, Carpinus betulus, Fagus sylvatica, Quercus petraea, Tilia cordata) to different constant photoperiods that occur before leaf-out in the latitudes of Zurich (10h, 11h, 12h, 13h). Two additional photoperiods of 8h and 16h served as a control to simulate shortest and longest natural occurring daylengths. The experiment was repeated on three occasions (from October 2019 to January 2020) to account for different dormancy depths. Bud development was monitored twice a week.

The experiment is still running. We expect that temperature-sensitive species would leaf-out regardless of the photoperiod, while photoperiod sensitive species such as beech may wait until a critical threshold has passed. Furthermore, longer photoperiods might substitute for insufficient chilling by decreasing the required amount of forcing to bud burst. The results could serve to better implement photoperiod into phenological models.