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Experimental assessment on the frost sensitivity during leaf development of juvenile Fagus sylvatica L.

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Late frost events in spring shape species distribution as well as reduce productivity. Till now, it is still not clear if future warming will lead to more frequent / stronger / more harmful frost damages in forestry and agriculture or not. Since the variability of extremes is increasing it seems that the risk of late frost damages in many regions may not decrease, even if the mean air temperature in general is increasing. A late frost event is only harmful if plants have initiated their leaf / flower development. Closed buds are usually very frost tolerant. However, once leaves develop after mild and warm spring periods, the new tissue is especially sensitive to freezing temperatures. Therefore not only the date of the last frost but also the weather history of the late winter / early spring determines if a frost event might result in frost damage or not. Tissue sensitivity to frost varies among species, but even within species there might be differences in frost tolerance during the different stages in leaf development. We set up an experiment to identify the frost risk in connection with the developmental stage of the leaves of juvenile beech. In order to vary the timing of frost events, we placed 1-year old potted beech trees 7times overnight in a climate chamber, in which the air temperature was cooled down to – 3° for five hours. For each tree the phenological stages were observed before and after the frost, the percent of damage was estimated after two days; additionally phenology of the damaged plants was observed weekly to document the recovery of their damage till May 23, 2013.
Only about 30% of the plants were damaged. In general it can be stated if damage occurred it was a severe damage, only very few plants sustained little damage. We observed dependence on the date of the freezing event, rather than on specific phenological phases - the later the frost was applied the more plants were damaged. Damaged plants recovered relatively rapidly from the frost damage; three to six weeks after the event most of the damage plants were foliated equally to non-damaged plants. Only a few plants did not recover at all from the frost event.