Lack of hydraulic recovery as cause of post-drought foliage reduction and canopy decline in European beech

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European beech (Fagus sylvatica) was among the most affected tree species during the severe 2018 European drought. It not only suffered from instant physiological stress but also showed severe symptoms of defoliation and canopy decline in the following year. To explore the underlying mechanisms, we used the Swiss-Canopy-Crane II site and studied in branches of healthy and symptomatic trees the repair of hydraulic function and concentration of carbohydrates during the 2018 drought and in 2019. We found loss of hydraulic conductance in 2018, which did not recover in 2019 in trees that developed defoliation symptoms in the year after drought. Reduced branch foliation in symptomatic trees was associated with a gradual decline in wood starch concentration throughout summer 2019. Visualization of water transport in healthy and symptomatic branches in the year after the drought confirmed the close relationship between xylem functionality and supported branch leaf area. Our findings showed that embolized xylem does not regain function in the season following a drought and that sustained branch hydraulic dysfunction is counterbalanced by the reduction in supported leaf area. It suggests acclimation of leaf development after drought to mitigate disturbances in canopy hydraulic function.
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