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2.4 SESSION D – WATER BALANCE AND TREE PHYSIOLOGY

2.4.1 Understanding time lag effects of the drought 2003 on physiological and phenological behaviour in oak and beech trees

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Dendroecological studies have clearly pointed out delayed effects of climatic stresses on radial growth, especially drought: tree ring width is reduced the year of drought, but the following tree ring is often narrower than the climate would predict. Moreover, we already demonstrated that stand leaf area index is reduced one or several years after a severe drought. Nevertheless, the underlying physiological processes are up to now not demonstrated. One may hypothesize that reduced photosynthesis due to stomatal closure will first stopped tree growth (direct effect) and secondly limited carbohydrates storage. This reduced storage would impair the following spring through reduced foliation, partial mortality and limited growth.

The aim of the presented study is to analyse the effect of drought 2003 on the replenishment of total non-structural carbohydrates amount in oak and beech trees. In a 35-40 year old beech stand, we selected 35 couples of dominant trees with premature (end of August) or normal leaf fall (end of October). We cored trees to analyse stem TNC content at the end of the growing season (October 2003). The premature defoliated beech exhibited significant lower starch content than normal defoliated trees, but no dead tree was observed in the 2004 spring. Phenological observations in Spring 2004 showed twigs mortality, heavy fructification, small leaves and we will discuss links between these events and the 2003 physiological status (defoliated or not, TNC content).

The Harth forest (Alsacian Plain) is an oak forest highly responsive to soil water shortage as a result of low soil holding capacity, high proportion of stones and high stand leaf area index. The recent oak decline has been retrospectively ascribed to recurrent droughts. In this forest, only light premature leaf-fall was observed in 2003 but brown and burned leaves were noted. More than 450 sessile or pedunculate oaks were there cored in October 2003, percent of brown leaves and leaf fall evaluated and TNC content quantified. We computed several water stress indices, taking into account local soil properties, stand leaf area index and species composition, as well as climatic data. We analysed the within and between stands variability of TNC content, especially starch, with respect to Spring 2004 foliation, twigs mortality and stand water balance. The relationships between drought intensity and phenological responses or carbohydrates reserves status of the two oak species will be discussed.