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STUDY OF ECOPHYSIOLOGICAL RESPONSES OF POPLARS EXPOSED TO HEAT STRESS

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Ongoing global climate warming is leading to increased frequency and intensity of heat and drought waves in several areas of the globe and thus having a huge impact on woody plant survival.

In order to characterize the heat wave effects on plant physiological and chemical responses, an experiment was carried out under heat stress conditions on potted poplar trees (*Populus tremula* × *alba*) placed in controlled growth chambers (phytotrons). After one month of plant growth adaptation (control conditions; light/dark photoperiod of 16/8 hours with a constant air temperature of 26/18°C), we imposed for 23 days a light/dark photoperiod of 16/8 hours with a constant air temperature of 40/24°C (heat stress). Pots of control plants were watered every 2 days in order to maintain container capacity; identical water amounts and timing were set for heat-stressed plants. Leaf gas exchanges, leaf water potential (Ψ_{leaf}) before and during imposed heat stress treatment, changes of pH values in xylem sap, content of total soluble sugars in different tissues and in sap were assessed.

High temperature conditions reduced significantly ecophysiological traits already after 4 days. Lower values of leaf and root water potential were measured in poplars exposed to heat stress in parallel with an impairment of stomatal conductance, photosynthesis and transpiration rates. Concentrations of soluble sugars in leaves and roots slightly decreased upon heat stress conditions, while sugar content significantly dropped in the stem of stressed samples. Furthermore, upon heat stress, poplars increased the sugar and ion contents in the xylem sap and contemporaneously decreased sap pH.

The results here obtained suggest that the heat stress occurred in combination with drought, as the expected reduction of stomatal conductance, caused by the heat stress-induced photorespiration, was not sufficient to allow high leaf water potential in stressed plants growing in pots where evaporation rates were elevated. Drought probably enhanced the effects of heat stress on the extent and type of plant responses, as confirmed by the measured sap acidification, one of the symptom/signal of stress in poplars experiencing severe drought.

The resulted combination of abiotic stresses had synergistic effects on plants; leaf gas exchange under high temperature were limited by heat and drought, as high evaporative demand superimposed on negative stomatal regulation caused by heat driven photorespiration.

The reduced capacity of poplar to photosynthesize during the combined stress, and thus the general reduction in carbon assimilation affected the total carbohydrate pool that could limit the plant growth and yields.

In conclusion, in the future climate scenario, characterized by rising temperatures, we can expect an increase of plant photorespiration that would reduce non-structural carbohydrate pool thus leading to reduced growth, higher rates of mortality and reduction of the tree yield.