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Direct effects of acidic wet deposition on photosynthesis and stomatal conductance of two *Populus* clones (*P.* cv. *Beaupré* and *P.* cv. *Robusta*)

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Introduction

Poplar, characterized by rapid growth, is an important source of fiber products in Belgium (Steenackers, 1982). Growth reduction due to acidic precipitation may have important economic consequences. Poplar is known to be sensitive to gaseous air pollutants (*e.g.*, leaf damage) (Freer-Smith, 1984; Wang *et al.*, 1986). In this study, direct effects of acidic precipitation on leaf gas exchange were determined for two clones.

Materials and Methods

Poplar cuttings (*Populus* sp. cv. *Beaupré* and cv. *Robusta*) were grown in a greenhouse in plastic containers (11.2 l) and exposed to simulated acidic rain of pH 4.0 or to a control solution of pH 5.6, 3 times a week. The soil was covered with a plastic hood to avoid indirect effects of acid precipitation.

The interactive effects of leaf age and exposure to acid rain on leaf gas exchange were studied by measuring net photosynthetic rate and stomatal conductance at different leaf ages (*i.e.*, different leaf plastochron index (LPI)). Measurements were obtained at light saturation, using an artificial light source (>800 $\mu E \cdot m^{-2} \cdot s^{-1}$): *PN*sat and $g_s$sat. Light saturated net photosynthesis data were obtained using a portable gas exchange system, as described by Ceulemans *et al.* (1986). Stomatal conductances were measured with an automatic water vapor diffusion porometer.

Mean values of 6–12 measurements of each LPI were calculated with 95% confidence limits. Non-overlapping limits indicate significant differences between the two pH treatments.

Results

Net photosynthesis was decreased by acid rain (pH 4.0) in cv. *Beaupré* (Fig. 1). The differences compared to the control group were highly significant for cv. *Beaupré* but not for cv. *Robusta*. These differences were greatest at optimal leaf age (LPI 9 for cv. *Beaupré*). A reduction (in *PN*sat) of 28.2% was recorded for cv. *Beaupré*.

Stomatal conductances ($g_s$sat) were calculated from stomatal resistance mea-

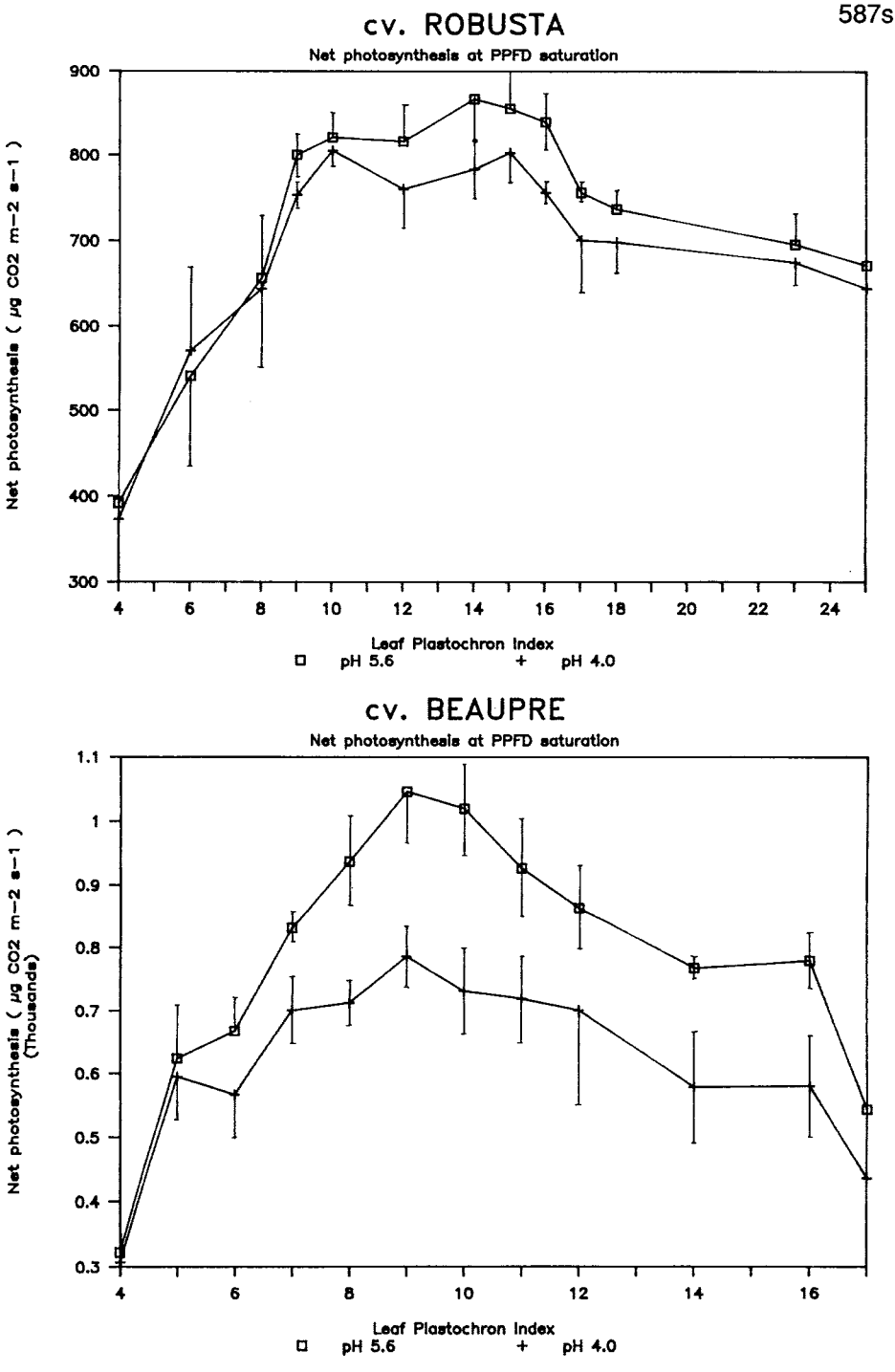

Fig. 1. Net photosynthesis, *PN*sat, at different leaf ages (LPI) for both pH groups. Bar: 95% confidence limit.

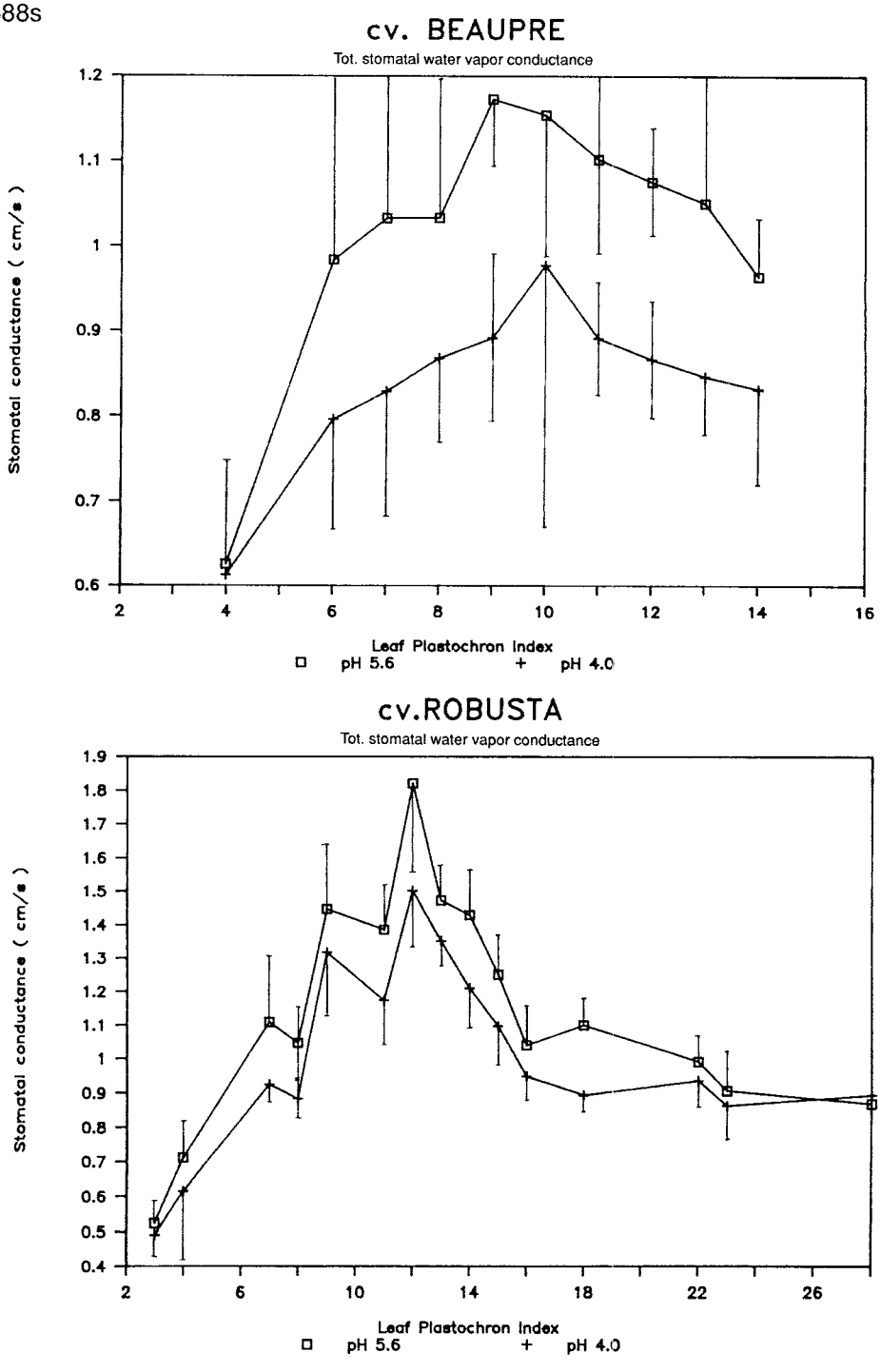

Fig. 2. Stomatal conductance, $g_s$sat, at different leaf ages (LPI) for both pH groups. Bar: 95% confidence limit.

surements of upper and lower leaf surfaces (Fig. 2). For both clones and treatments, $g_s$sat shows its maximal value on fully expanded leaves. The optimal leaf ages were LPI 9 for cv. *Beaupré* and LPI 12 for cv. *Robusta.* On the whole, acid rain caused a decrease of stomatal conductance; $g_s$sat was reduced by 24.0% for cv. *Beaupré* and by 15.4% for cv. *Robusta.*

Discussion and Conclusions

Both clones showed a decrease for *PN*sat as well as for $g_s$sat. Cultivar *Beaupré* was much more sensitive to acid rain treatment than cv. *Robusta,* as well for photosynthesis as for water vapor conductance. Effects of treatment were statistically significant ($P = 0.05$) for cv. *Beaupré*, but not for cv. *Robusta.* Maximal sensitivity corresponded to maximal leaf gas exchange rates (optimal leaf ages).

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