High density coppice culture of poplar: clonal differences in biomass production, shoot and stool mortality

I. Laureysens*, W. Deraedt, R. Ceulemans
University of Antwerp (UIA), Department of Biology, Universiteitsplein 1, B-2610 Wilrijk, Belgium
Fax: + 32 3 820 22 71; ilaureys@uia.ua.ac.be

The use of alternative, renewable energy plays a major role in the efforts to reduce the carbon dioxide emission levels. Energy crops, and tree biomass crops in particular, are among the most promising renewable energy sources. Tree biomass cropping or short rotation forestry (SRF) refers to woody biomass production in carefully tended plantation using fast growing hardwoods for rotations shorter than 15 years.

A high-density, intensively cultured plantation of different poplar (*Populus*) clones was established in April 1996 in an industrial area close to the city of Boom (province of Antwerpen, Belgium). The site had a very heavy, unfertile and slightly contaminated (with heavy metals) soil with lots of rubble and clay. Initial planting density was 10,000 hardwood cuttings per ha. Seventeen poplar clones were planted in a randomised block design with three replicates per clone. They belonged to the species *P. nigra* (clone Wolterson), *P. trichocarpa* (clones Columbia River, Fritzi Pauley and Trichobel), and to the interspecific hybrids *P. trichocarpa x P. deltoides* (clones Unal, Beaupré, Boelare, Raspalje, Hazendans, Hoogvorst), *P. trichocarpa x P. balsamifera* (clone Balsam Spire), *P. deltoides x P. nigra* (clones Gaver, Gibecq and Primo) as well as to some unreleased *P. deltoides x P. trichocarpa* hybrids (clones IBW1, IWB2 and IBW3). All trees were cut back in December 1996 to create a coppice culture. In January 2001 the plantation was harvested to start a new rotation. Non-destructive, but frequent measurements of shoot diameters and numbers have been made over the entire four-year coppice rotation. Destructive biomass assessments were made after the establishment year as well as after three and four years after coppice [1].

Significant clonal differences were observed in coppice and resprouting ability, in shoot and stool mortality and in biomass productivity [2]. Clone Gaver had the highest stool mortality (54.7 %), reducing the original planting density from 10,000 plants ha^{-1} to as little as 4500 plants ha^{-1}. Clone Fritzi Pauley had the lowest individual cutting mortality (0%). On average two shoots per cutting emerged shortly after planting. During the establishment year three clones, i.e. Wolterson, Balsam Spire and Gaver, produced more than 20,000 shoots ha^{-1}, while clones IBW3 and Boelare produced less than 14,000 shoots ha^{-1}. While on average four to five sprouts per stool were generated immediately after coppice, only one to two sprouts per stool survived during the following four years. Total shoot mortality over the four year rotation period after coppice ranged from less than 20% for clones Gaver and Gibecq to more than 160% for clone IBW1. Mean annual biomass ranged from 2.0 Mg ha^{-1} for clone Gibecq to 10.4 Mg ha^{-1} for clone Hazendans. The T?D clone Hazendans reached a maximum replicate dry mass yield of 14.3 Mg ha^{-1} $year^{-1}$. Biomass results and shoot dynamics will be presented and discussed in more detail.

Acknowledgements
Research was in collaboration with the Flemish Institute for Forestry and Game Management (IBW, Geraardsbergen), the city council of Boom and the Eta-com B private company. Funding was provided by the Fund for Scientific Research - Flanders (FWO grant no G.0108.97), by the Prime Minister's Office, Federal Office for Scientific, Technical and Cultural Affairs (contract no. GC/DD/254) and by the Province of Antwerpen.

References
[1] Laureysens, I., E. Casella, and R. Ceulemans (2000) Productivity, basal area and shoot density of different poplar clones in a coppice culture, in Topics in ecology: structure and function in plants and ecosystems, R. Ceulemans, *et al.*, Editors. 2000, University of Antwerp. p. 29-38.
[2] Casella, E., Laureysens, I., and Ceulemans, R. (2001) Simulating carbon fluxes and biomass production in short rotation poplar coppice culture: proposition for a dual-way modelling approach. In: Conference Proceedings of the 1st World Conference and Exhibition on Biomass for Energy and Industry, James & James (Science Publishers) Ltd., London, (in press).