Poplar and willow short-rotation coppice response to fertilisation in a lysimeter-based trial. Results of the first rotation

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Introduction

The main goal of cultivating SRC is represented by their potential role as a renewable energy source. Several studies have recently focused on willow and poplar growth and productivity, but most of them have never been conducted in lysimeters where plants can usually grow under optimal environment conditions with particular regard to water and nutrient supply. A lysimeter allows a specific crop to grow throughout the season without risk of water shortage. Therefore, growth and biomass production obtained may indicate the potential for a specific crop grown under specific climate conditions.

Material and methods

This research was carried out in San Piero a Grado, Pisa (north-central Italy) (43ºN, 11ºE; altitude 5 m a.s.l.) under typical Mediterranean conditions. In winter 2002, twelve drainage lysimeters were set up in the field. Each lysimeter was provided with an automatic system that maintained soil humidity around field capacity. In March 2003, two 0.2 m cuttings of *Salix alba* (clone SI62-059) and *Populus deltoides* (clone Lux) were planted 0.40 m apart in each lysimeter (10.000 plants ha^{-1}). All the stems were harvested at the end of the first year. Lysimeters of each species were assigned either a solution of only tap water (NF) or of the nutrients of N and P (F), in order to estimate the effect of fertilisation on biomass production. The annual amount of fertiliser applied for the three years was respectively: 120 kg, 200 kg, and 300 kg ha^{-1}. Height and diametric growth, as well as number of shoots per plant were registered every 15 days throughout the duration of the trial. Biomass production was determined at the end of the establishment year and at the end of the second year after coppice.

Results

During the first year, poplar stem size was, on average, higher than willow for both treatments. It ranged from 305 (NF) to 347 (F) cm, whereas in willow it ranged from 186 (NF) to 229 (F) cm. Significant differences were only due to the effect of the species and not the treatment. Average diameters ranged respectively from 28.3 (NF) to 35.4 (F) mm in poplar and 16.7 (NF) 20.4 (F) mm in willow. Statistical differences were due both to the species and treatment. Number of shoots per plant were instead higher in willow (both treatments) than in poplar. Oven dry biomass at the end of the season was respectively 3.13 (NF) and 7.72 (F) t ha^{-1} in willow and 3.70 (NF) 8.24 t ha^{-1} in poplar, and differences were mainly due to the effect of nutrient supply.

At the end of the first year after coppice, average stem height ranged from 227 (NF) to 254 (F) cm in poplar and 149 (NF) to 294 (F) cm in willow, but no significant differences were found either between species or between treatments. Diameters ranged from 15.4 (NF) to 25.7 (F) mm in poplar to 8.9 (NF) to 25 (F) mm in willow, showing differences determined by the treatment. Number of shoots per plant was still higher in willow than in poplar, and such differences increased after coppice.

Average stem dimensions at the end of the second year after coppice showed a general increase in differences among fertilised and non-fertilised plants. Height ranged between 330 (NF) and 430 (F) cm in poplar and 173 (NF) 446 (F) cm in willow, whereas average diameters ranged from 30.1 (NF) and 54.7 (F) mm in poplar and 11.5 (NF) and 41.2 (F) in willow. Number of shoots per plant did not change and was still determined by species. Aboveground biomass at the end of the second year was respectively 8.9 (NF) 44.4 (F) t ha^{-1}in poplar and 6.28 (NF) 63.8 (F) t ha^{-1} in willow.

Main conclusions

- Fertilisation positively affected poplar and willow growth and biomass production.
- Nevertheless, at the end of the second year after coppice, the two species showed a different response to different fertilisation levels.
- Under fertilised conditions (F) willow performed better than poplar

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