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Productivity of seven clones of willow coppice in annual and quadrennial cutting cycles

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ABSTRACT

In a field trial yield of oven dry matter of seven willow clones from own collection grown in two cutting cycles (annual and quadrennial) as well as plant biometric features were studied. Willow grown in annual cutting cycle planted at density of 40,000 cuttings ha^{-1} showed losses of 23.3% in case of hybrid *Salix viminalis* × *Salix purpurea* clone 1001 the higher losses were found while it was grown in quadrennial cutting cycle. It was found that on a very fertile soil (*Mollic Fluvisols*) under conditions of northern Poland all of studied genotypes in annual cutting cycle showed high productivity. Genotypes of species *S. viminalis* also maintain high yielding ability when cutting cycle was prolonged to 4 years. The highest yield irrespectively of cutting cycle was found *S. viminalis* for clone 1058.

1. Introduction

Perspectives of depleting of fossil fuels resources and environmental concerns caused growth of interest in utilization of renewable sources of energy in old countries of EU. Nowadays this interest is seen also in Poland. In the Strategy of the Development of Renewable Energy Sector in Poland is assumed that the share of energy from renewable sources in Poland should amount to 7.5% in 2010 and 14% in 2020 [1,2]. According to regulations by Ministry of National Economy issued on December 19, 2005 share of electricity generated from renewables in 2005 should not be lower than 3.1% and growth to 9.0% in 2014 should be achieved [3]. In 2004, share of renewable sources (peat, wood, water, wind and sun) in a general balance of crude energy production was estimated to 3.4% what means that growth by factor of two should be achieved to 2010. In a structure of renewable resources leading position in Poland has biomass. Share of biomass in the production and consumption of renewable energy was estimated to ca. 94% in 2004.

Currently in Poland biomass is obtained from forestry, wood-processing plants, maintenance of municipal green areas and in small amounts of organic fraction of segregated municipal wastes. In a close future supplement of the biomass balance can be obtained from short-rotation plantations (SRPs) of willow coppice—*Salix* spp., *Miscanthus sinensis giganteus*, Virginia mallow—*Sida hemaphrodita* Rusby) and other crops [4].

Under Polish conditions, it seems the highest potential have a native species and willow is the best example. In 2005, area of willow plantations for energy in Poland amounted to 6000 ha [5]. The base of newly established SRPs can be set aside areas. In Poland area of set asides in 2004 amounted to 1.4×10^6 ha. Willow can grown on polluted areas where traditional food crops should not be grown. In the result to willow growing polluted soils of good fertility can be returned into production because willow has a good phytoremediation potential combined with high productivity [6–8].

As it was shown from many authors' reports productivity of willow clones depends on proper selection of genotype,

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cutting frequency, specific conditions at the site and agricultural management practices [2,9–17].

The aim of presented studies was to determine the productivity and morphological features of seven clones of willow coppice grown in annual or 4-year lasting cutting cycles.

2. Materials and method

2.1. Experimental site

Field trial was established in the spring 2000. It was located in the north Poland in the Kwidzyn Valley in Obory village 80 km south from city of Gdańsk. Kwidzyn Valley is a northern part of Lower Vistula River Valley of width ranged from 6 to 9 km (Fig. 1). The bottom of the valley lowers westbound to 9 m below sea level and slopes are 50–70 m high.

According to system presented by Kwiecień [18], this area is classified to Lower Vistula River Valley and Żuławy. The weather pattern in Vistula River Valley created a specific microclimate of high air humidity but of low precipitation rate with frequent fogs occurrence and ground frosts in late spring and early autumn. High amplitude of annual temperature is typical for this region and the highest (around 20 °C) is in Kwidzyn outskirts. The highest temperature reaches 33 °C. The warmest month is July of mean monthly temperature of 17.5–18 °C and the coldest month is February of −3.5 °C. Number of days with frosts i.e. with maximal daily temperature lower than 0 °C ranges from 30 to 50 per year. Growing period lasts 200–210 days. Precipitation sums on monthly and annual base are lowest in the whole Pomorskie region. It can be treated as precipitation deficiency area. The annual precipitation sum amounts here to 400–500 mm. Average annual number of days with precipitation amounts to 160–170 including 30–40 days with snowfalls. Average annual number of days with snow cover is 60–70 days. In spring and summer west winds are predominant whereas is autumn and winter north-west or west winds are more frequent.

2.2. Preparation of site, soil characteristics

The experimental site was for ten years managed as meadow and harvested forage was used as fodder for meat cattle, then alfalfa was sown which was forecrop for willow coppice. Before trial establishing in the summer 1999 glyphosate was applied at the rate of 3.5 l ha^{-1} to kill alfalfa and perennial weeds. Then disk harrowing together with potassium salt application at the rate of 100 kg K ha^{-1} were performed. In the late autumn 1999, ploughing at the depth of 35 cm was done. The shallow harrowing was done in the early spring 2000. Just after planting of willow cuttings simazine at the rate of 1 kg ha^{-1} was applied and during the willow growth manual weeding was twice performed. In the succeeding seasons, no plant protection measures were made. In planting year no

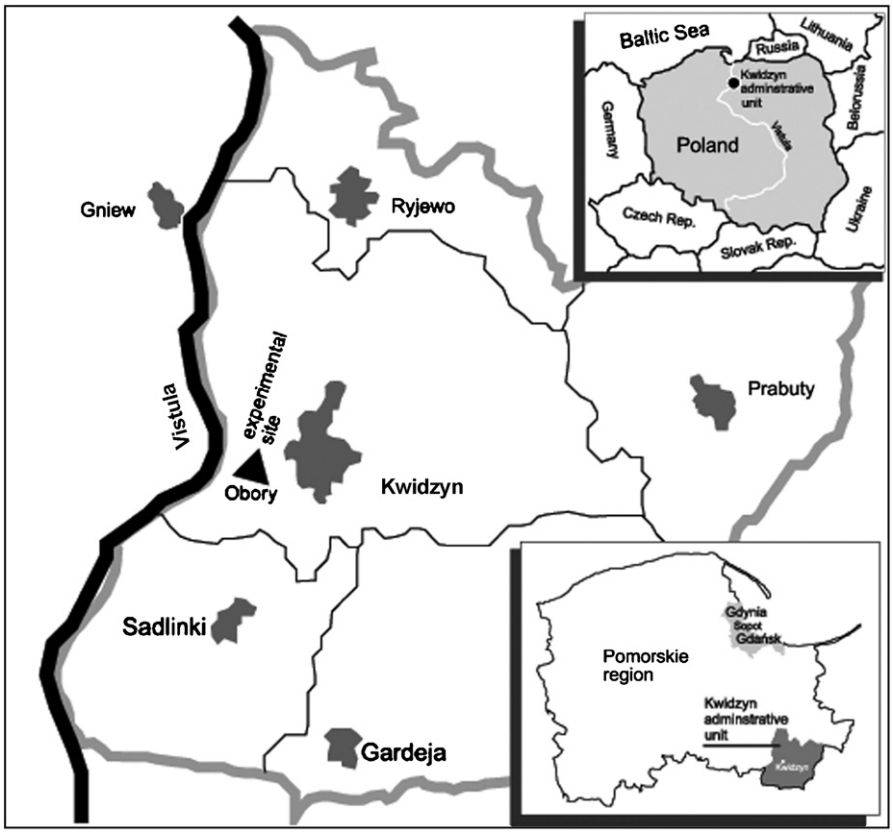

Fig. 1 – Localization of the field trial.