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DIVERSIFICATION OF THE AGRICULTURE AIMED TO BIOENERGY PRODUCTION

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Abstract

Long-term target by 2050 set by the European Commission is based on the development of the competitiveness of the economies that efficiently handles with the natural resources and contributes to reducing carbon emissions. Competitiveness can be increased also by diversification. Later it was integrated the concept of green (low carbon) economy into general policy framework at the national policies of the Member States. Diversification orientation into the bioenergy production represents the use of agricultural land for targeted growing of fast-growing plants under specific conditions. The article evaluated varietal conditionality of Populus biomass production based on soil and ecological conditions of southern Slovakia. The research was realized in the vegetation year 2012 (the last year of the first growing cycle) and 2013 (the first year of the second growing cycle) on a research area in the village Kolíňany, Slovakia. Return cut of the trees (at the end of the vegetation in 2012) influenced biomass production the first year of the second growing cycle by all grey poplar varieties. By all varieties the biomass production in the harvest moisture (t ha^{-1}) decreased in the range from 71.5% variety Monviso to 80.9% Pegaso. Production of dry mass (t ha^{-1}) decreased in the range of 80.28 to 81.70% by three varieties -Pegaso, AF-2 and Sirio. The lowest decrease of dry mass has been researched in a variety Monviso (74.85%). All grey poplar varieties exceeded in the first year of the second growing season (a year after re-section) economic yield limit (12 t of dry matter. ha^{-1}.year^{-1}).

Key words: *bioenergy, biomass, diversification, Poplar*

INTRODUCTION

Diversification of agricultural production directed towards the production of bio-energy forced a social demand for identification of habitats (soils), which are suitable for this purpose. They must fulfil the conditions for cultivation of specific species of crops, but also with regard to protection for primary food production [9].

The long-term goal by 2050 that was set by the European Commission is based on the development of the competitiveness of the economy that efficiently handles the natural resources and contributes to reducing carbon emissions. Competitiveness may increase just diversification. Later concept of green (low carbon) economy was integrated into general policy framework at the national policies of the Member States [4].

Agriculture as an economic sector is strongly specific in comparison with other sectors of the national economy. In addition to the significant role as producer of food, raw materials and energy, while ensuring for the society ecological landscape stability, biodiversity also contributes to environmental protection. The current concept of agriculture in the EU includes the environmental functions of agriculture linked to rural settlements. Agriculture is directly linked to the ecosystems and operates in the area taking into account the achievement of competitiveness [10].

Green economy brings opportunities for business development, opening up new markets with efficient and ecological use of natural resources. This transfer would mean an increase in use of natural resources and lead to increased demand for biomass. The increased demand for biomass opens up new questions about the sustainability of the green economy [11].

Under the term bioenergy production we understand the deliberate cultivation of specific plant species in order to develop cost-

effective biomass [2].

An important dimension of fast-growing energy crops is the ability to achieve in a short time a substantial annual increase in biomass and high biomass production after just a few years after planting. For this purpose, it is possible to grow willow, poplar and herbaceous species, for example *Miscanthus* [7].

The growing specific crops on agricultural land have to use special scheme. This is directly determined by Actno. 220/2004 on the protection and use of agricultural land and on Act no. 245/2003 on integrated prevention and control of environment pollution and on amendment of certain Acts [12].

The paper evaluates varietal conditionality of woody biomass production of genus *Populus*.

MATERIALS AND METHODS

Specific environmental conditions for the cultivation of fast-growing plants can be defined by Act no. 220/2004, namely Section 18a. The minimum acreage for planting fast-growing trees is 1000 m^2 for a maximum period of 20 years. Stand of fast growing plants can be set up on agricultural land, which is included by code BSEU in 5th to 9th of quality, grade contaminated soil, or is classified under code BPEJ to 3 or 4 of the quality of the land located on flood plains, is waterlogged, or exposed to wind erosion and which is outside the 3rd to 5th degree of nature protection.

An overview of the biological factors affecting growth and biomass production in soil-ecological conditions of southern Slovakia is treated in the works team of authors [5] and [6].

The research was conducted in the years 2012 - 2013 on the sites of farm of Slovak University of Agriculture in Nitra, in the village Kolíňany, Slovakia. Research habitat is located at an altitude of 180 m above sea level and it belongs to the region's warm climate, very dry and lowland. The average annual temperature is 9.9 °C, the average annual precipitation for the period 1951-2000 is 547.6 mm. The soil in the research station is moderate (loam), fluvisol with an average pH 7.26 containing 1.8% of the humus.

The subject of evaluation is the production of woody biomass of the genus *Populus*. The four Italian varieties have beenevaluated: Monviso (*Populus* × *generosa* × *Populusnigra*), Pegaso (*Populus* × *Generosa* × *Populus nigra*), AF-2 (*Populus* × *canadensis*) and Sirio (*Populus deltoids* × *Populus* × *canadensis*). The characteristics of different variety are processed in [3].

RESULTS AND DISCUSSIONS

Areas potentially suitable for planting fast-growing trees in the Slovak Republic make the space that can be used in order to diversify agricultural production. As shown in Figure 1, the land potentially suitable for fast growing tree species is found in all regions of the Slovak
Republic.

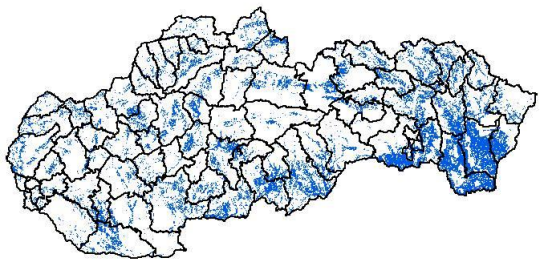

Fig. 1. Areas potentially suitable for fast growing tree species [9]

Results from the crop biomass observed in the growing poplar varieties in 2012 and 2013 are shown in Table 1.

Vegetation year 2012 is the fourth (final) vegetation year of the first growing cycle. Vegetation year 2013 represents the first year of the second growing cycle. Return cut was made at the end of the growing season of 2012.

Average yield of poplar varieties biomass (Table 1) were in the range from 15.83 kg of a variety AF-2 to 21.16 kg of a variety Monviso. These individual differences in crop biomass are also reflected in the biomass crop varieties as referred to in t ha^{-1}. The average yield of biomass in the investigated varieties harvested at moisture ranged from 140.74 t ha^{-1} in a variety of AF-2 to 188.14 t ha^{-1} of a

variety Monviso. By 44.76 and 47.91% dry mass were average yield of biomass in dry mass for different varieties in the range from 67.42 t ha^{-1} in a variety of AF-2 to 87.16 t ha^{-1} in a variety Monviso.

Table 1.Biomass yields of the varieties of *Populus* × *canescens* in the vegetation year 2012 and 2013

Varieties	Replicate		Biomass yield											
			Average biomass yield per individual plants [kg]		Average biomass yield of the studied varieties [kg]		Average biomass yield of individual plants at harvest moisture [t·ha^{-1}]		Average biomass yield of the studied varieties a harvest moisture [t·ha^{-1}]		Content of dry matter [%]		Average biomass yield of the dry matter of the studied varieties [t·ha^{-1}]	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Monviso	1	1	18.60	6.9	21.16	6.03	165.33	61.34	188.14	53.56	46.33	40.92	87.16	21.92
	2	2	17.80	7.7			158.22	68.44						
	3	3	27.10	3.6			240.89	32.00						
	-	4	-	5.9			-	52.45						
Pegaso	1	1	15.60	2.6	18.83	3.75	138.66	23.11	167.40	33.34	45.94	42.25	76.90	14.09
	2	2	16.40	1.2			145.77	10.67						
	3	3	24.50	5.3			217.75	47.11						
	-	4	-	5.9			-	52.45						
AF-2	1	1	15.90	6.6	15.83	3.43	141.33	58.67	140.74	30.45	47.91	40.53	67.42	12.34
	2	2	9.90	2.4			88.00	21.33						
	3	3	21.70	2.4			192.89	21.33						
	-	4	-	2.3			-	20.45						
Sirio	1	1	16.80	5.8	19.76	4.00	149.33	51.56	175.70	39.78	44.76	38.98	78.64	15.51
	2	2	20.00	3.3			177.78	29.33						
	3	3	22.50	5.4			200.00	48.00						
	-	4	-	3.4			-	30.22						

Source: Own calculation

Table 1 also presents the average crop biomass of the individual grey poplar varieties in the first year of the second growing cycle. It was in the range of 3.43 kg of a variety AF-2 to 3.6 kg of a variety Monviso. These individual differences in crop biomass in are also reflected in the biomass crop varieties as referred to in t ha^{-1}. The average yield of biomass of the researched varieties at harvested moisture ranged from 30.45 t ha^{-1} in a variety of AF-2 to 53.56 t ha^{-1} in a variety Monviso. At 38.98 and 42.25% dry mass average yield of biomass in dry mass for different varieties were in a range from 12.34 t ha^{-1} in a variety of AF-2 to 21.92 t ha^{-1} in a variety Monviso.

Return cut made at the end of the first growing seasons affected the production of biomass in all studied varieties of grey poplar (for all varieties were confirmed the significant decrease of biomass). The three studied varieties (AF-2, Sirio and Pegaso) decreased the biomass production in the harvested moisture (t ha^{-1}) in the range of 78.33 to 80.09%. The lowest decrease of biomass in the harvest moisture (t ha^{-1}) was confirmed by variety Monviso (71.5%).

By the three varieties Pegaso, AF-2 and Sirio was the formation of dry mass (t ha^{-1}) decreased in the range of 80.28 to 81.70%. The lowest decrease of dry mass has been confirmed by the variety Monviso (74.85%). From the economic point of view is by the cultivation of energy crops most important the production of biomass. The economic limit for growing poplar is the yield 10-12 t dry mass. ha^{-1}.year^{-1} [8].

For comparison in the US, they consider yield 12 t of dry mass. ha^{-1}.year^{-1} from an economic point of view as acceptable [1].

In this research, all varieties of grey poplar exceeded the economic yield limit.

CONCLUSIONS

The Slovak Republic has soils that are suitable for the use of non-food production and that there can be used of the diversification in agricultural production.

As suitable tree species for biomass production for energy use in order to diversification of agricultural production in the Slovak Republic can be poplar (*Populus*).

Return cut of the trees affected biomass production the first year of the second growing cycle at all grey poplar varieties. For all varieties, biomass production in harvest moisture (t ha^{-1}) decreased in the range from 71.5% variety Monviso to 80.9% variety Pegaso. There was observed the reduction of production of dry mass by the three varieties Pegaso, AF-2 and Sirio in the range of 80.28 to 81.70%. The lowest decrease of dry mass has been reported in the variety Monviso (74.85%).

All grey poplar varieties exceeded in the first year of the second growing season (a year after re-section) economic yield limit (12 t of dry matter. ha^{-1}.year^{-1}).

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