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Biomass production of some Swedish willow hybrids on the West of Romania. A case study

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Abstract Willow short rotation coppice is not very common in Romania. The first crops date from 2006 but were attempts on small areas. There haven't been reported very good results for willow Swedish clones in specific conditions of our country. This is the reason why we try to test biomass production of willow clones on a meadow alluvial soil of Bega River. In this regard, an experimental culture with seven Swedish willow hybrids (Gudrun, Inger, Klara, Stina, Olof, Tora, Tordis) have been established. The aims of this study were to quantify the biometric characters and biomass production on different willow hybrids. The results showed significant differences in terms of shoots biometric characters for all analyzed clones. There have been highlighted correlations between diameters and the height of the shots. In terms of dry biomass, satisfactory results were obtained for clones Olof and Stina.

Key words

willow, biomass, biometric observation

The energetic willow, with short rotation cycle and vegetative regeneration, is a ligneous and shrubby plant, having a rapid growth. From this culture, it can be obtained at least 30-40 t of usable biomass as an energy source in a form of chips, briquettes, pellets. This short rotation coppice (SRC) plantation began to be more and more interesting in many countries (Weihand Nordh, 2005; Mola-Yudego and Pelkonen, 2008; Mola-Yudego, 2010). A great benefit of willow SRC is that this culture can be deployed in medium fertility areas and marginal lands production (Helby et al., 2004). Currently, there are numerous varieties and hybrids of great production, created especially in Sweden, with high plasticity and adaptation to different climatic and soil conditions. In Romania, there has been established culture with different Swedish genotypes like Gudrun, Inger, Klara, Olof, Stina, Sven, Tora, Tordis etc. The objective of this research is to test the biomass production of Swedish hybrid willow.

Materials and Methods

In 2012 a field trial was established in Romanesti, Timis County Romania (Trava, 2014). The trail was organized on a meadow alluvial soil of Bega River and consisted of seven Swedish willow hybrids: Gudrun (*Salix dasyclados*), Inger (*Salix triandra, S. viminalis*), Klara (*Salix dasyclados, S. viminalis, S.schwerinii*), Olof (*Salix viminalis, S. schwerinii*), Stina (*S.aegyptiaca, S. schwerinii, S. viminalis, S. lanceolata*), Sven (*Salix viminalis, S. schwerinii*), Tora (*Salix schwerinii , S. viminalis*), Tordis ((*Salix schwerinii*, *S. viminalis*) (Castlin et al., 2012)

The field was prepared for planting in the autumn 2011 by chemical weed control and ploughing and then in spring 2012 the soil was cultivated. The field were planted with 14 cuttings from each genotype in one replication (1.4m between double rows, 0.7m between rows, 0.7m between cuttings).

To assure good results of the crop in order of a strong radicular system, growth, pest and disease resistance and high biomass production, 200 kg/ha fertilizer (N.P.K.:10.30.0.) have been applied. Chemical weed control were conducted in 2012, manual and mechanical methods have been conducted in 2013 and 2014.

Biometric observation (shoot diameter and height) have been made in 2014.

Willow SRC was harvested in winter, in the third year after establishment. Harvesting was performed using scythe mower. Then the shoots were weighed and transported to BUASVM laboratory for all determinations required.

Biomass estimation was performed at the end of the growing seasons by drying material at 105^0 C, until constant weight.

Statistical analyses have been done by STATISTICA 10 soft.

Results and Discussions

The percentage of willow plants survival ranged from a clone to another (Table 1). For two of the studied

clones all plants died. In order of biometric characters, significant differences ($p<0,05$) have been reported for all analyzed clones (table 2). The highest values were registered for clones Stina and Olof but even for these clones the average shoots diameters were lower according with fact that harvesting are profitable when the diameter of the trunk at the base of the thickest shoots exceeds 6 cm (Lantmännen Agroenergi, no date). Only for two clones shoots with diameter higher than 5 cm have been reported for all others clones, the shoots diameters were very thin (Fig.1). The lower values of shoots diameters have not been correlated with the number of shoots per stump (Fig. 2).

Table 1

Survival rate for different willow in experimental trail Romanesti, Timis Cunty

clone	Gudrun	Inger	Klara	Olof	Stina	Tora	Tordis
Survival rate (%)	0	29	86	93	79	64	0

Table 2

Shoot diameter and height for different willow hybrids (media+SE), in experimental trial Romanesti

clona	diameter (mm)				height (cm)			
Inger	1.404444	±	0.073070	c	174.7778	±	19.53542	d
Klara	2.213125	±	0.171997	b	302.8750	±	31.38164	c
Olof	3.606071	±	0.208211	a	514.8571	±	20.57717	a
Stina	3.448824	±	0.309944	a	416.5294	±	37.45646	b
Tora	2.102500	±	0.322648	b	270.0833	±	43.15765	c

Note: Different letters between cultivars denote significant differences (Duncan test, $p < 0.05$).

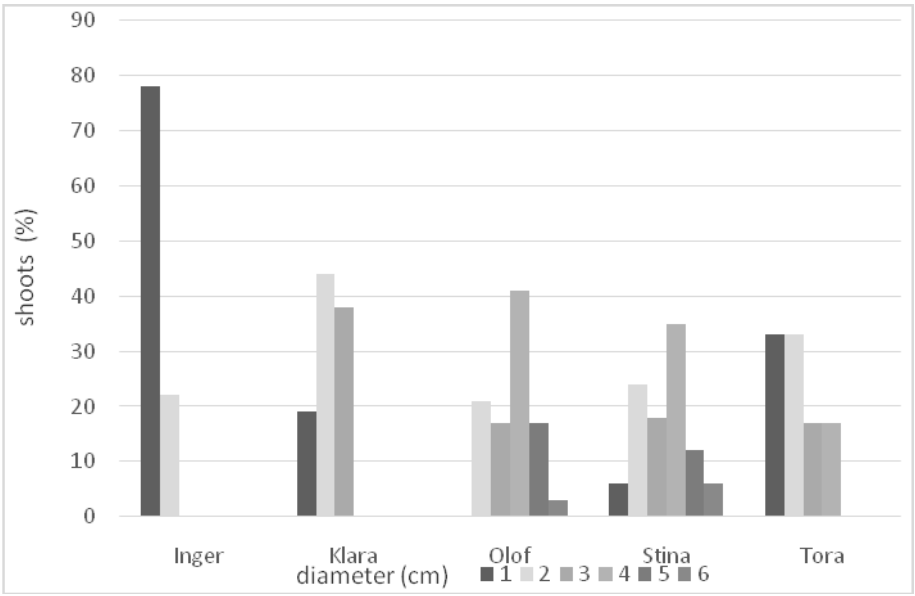

Fig. 1 Distribution of shoots per diameter classes (six diameter classes, from 1 to 6 cm, amplitude is 1 cm) for five willow Swedish clones, % from total number of shoots per clone

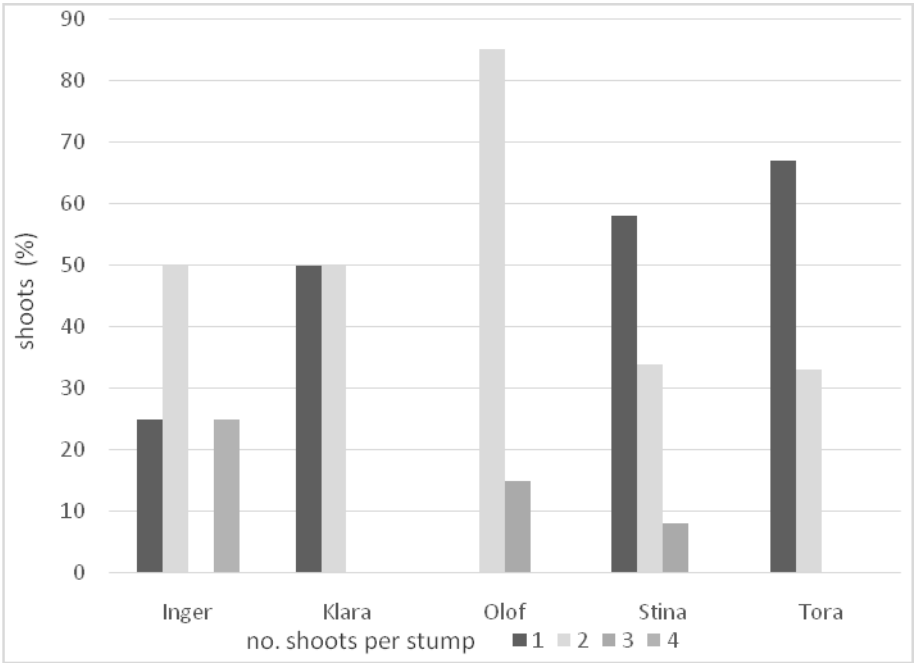

Fig. 2 Distribution of shoots per stump (four categories with 1, 2, 3 or 4 shoots per stump for five willow Swedish clones, % from total number of shoots per clone

According with shoots length, significants differences ($p<0,05$) were registered between Swedish willow clones. We can see, like in diameter case, a special place occupied by Olof clone, the highest average values were registered for this clone (table 4).

There were established significants correlation ($p<0,05$) between shoots diameter and length for all five willow clones (table 3).

Table 3

Willow within-Group Correlations

Characters	clona				
	Inger	Klara	Olof	Stina	Tora
Shoot diameter (mm) –shot height (cm)	**0.810195**	**0.922837**	**0.876078**	**0.940886**	**0.977250**

Marked correlations are significant at $p < .05000$

Willow SRC in cultivated to produce biomass so the production is the most important. In this aspect, green biomass and dry biomass (table 4) were determined.

Table 4

Green biomass and dry biomass for different Swedish willow clones (mean+SE), in experimental trial Romanesti

clona	Green biomass (kg/plant)				DM(tone/ha)			
Inger	0.296	±	0.110	b	1.685	±	0.580	b
Klara	0.878	±	0.211	b	5.220	±	1.206	b
Olof	4.177	±	0.630	a	20.601	±	3.125	a
Stina	2.938	±	1.070	a	18.277	±	6.954	a
Tora	0.729	±	0.292	b	11.733	±	2.079	b

Note: Different letters between cultivars denote significant differences (Duncan test, $p < 0.05$).

The superiority of Olof and Stina clones ere highlight in particular area Romanesti.

Conclusions

Results obtained in willow SRC in an experimental trial in West of Romania was not as good as we expected. Two of the tested willow hybrids did not reach with sites and all the individuals died. For others clones, there have been established significant differences ($p<0,05$) for the biometric characters shoot diameter and height. The both characters are not very high value so the biomass production was low but except clones Olof and Stina, for these clone both biometric characters and biomass production are satisfactory. The research was established as a screening for future experiences according with the culture of Swedish willow hybrids in our country site conditions.

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