

Fast growing tree species and energy grain in Austria

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Introduction

In the Kyoto Agreement from 1998 until the period 2008 -2012 the reduction of the discharge of CO₂ , CH₄ , N₂O around 13 % to 1990 is demanded. This goal is not within reached by the Austrian government, the reasons are multiple like increasing traffic (transit through Austria by European trucks), private heating with fossil energy, fossil power plants and others. 1990 the emission of CO₂ equivalent was 77 Mio t per year, increased 1998 to 80 Mio t - in the agreement a reduction to 67 Mio t is requested.

These goals can be reached by renewable bio energy, but there is a deficit in timber production and an increasing demand to be noticed. 2007 in Austria 1.800 ha fast growing trees like poplar and willow are cultivated, in the next years an expansion is expected. The reason for this purpose is, that 2 – 2.5 kg timber can replace 1 kg heating oil. The harvest is full mechanised and after 15 – 20 years a recultivation is possible and aimed. This kind of bio energy production can hold open the countryside, an important aspect for the tourism in Austria. Fast growing trees have an enormous positive energy balance and bring good yields. The production is full mechanised as well, only herbicides have to be found. Cover crops between the rows prevent soil erosion, grooming saves moisture.

Another aspect of bio energy production are biogas plants, bio fuel and energy grain for combustion. The heatings are more or less tested.

Material and Methods

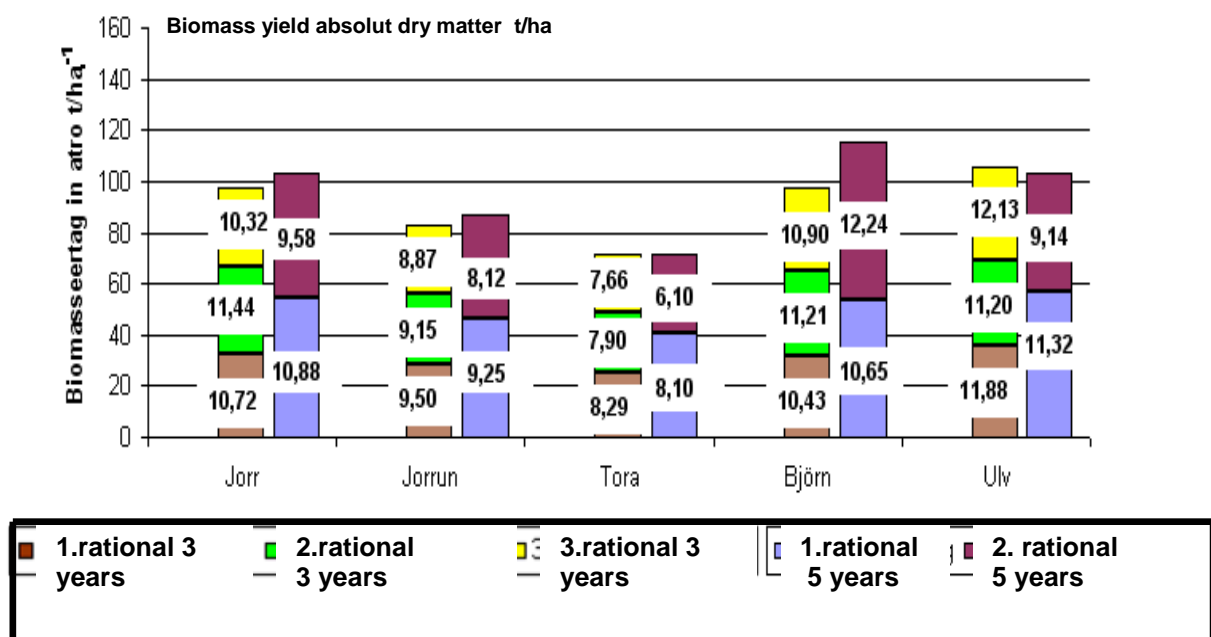
In Lower Austria fast growing trees are tested since 1996 on one location in the western part of the Province. Willow from Sweden and poplar from Austria were planted, in the trials the harvest took place every 3 years or every 5 years. Double rows with a row space of 150 – 250 cm and spacing in the row of 50 cm were

planted. Between the rows cover crops (xeric grassland communities – clover) were seeded, before planting the fertilization took place with liquid manure. Grooming twice – three times a year saves soil moisture and controls weeds. In the rows under leaf herbicide spraying with Basta (common name, active substance Glyphosinate) controls weeds, especial Clematis vitalba. From 2006 on Swedish clones from willow and Italian clones from poplar were planted. In dry areas poplar grows more vital than willow, in wet areas the situation is reverse.

Results

In the following graph 1 the results of the test of varieties of willow and poplar from Amstetten, situated 100 km west of Vienna, are represented. 3 years and 5 years rational were tested from 1996 an

Graph 1: Results test of varieties willow Lower Austria – moderate transition climate (Amstetten – 100 km west of Vienna), Start 1996



The results show, that the tested varieties from willow bring 6 – 11 t dry matter per ha and year. Differences between 3 year harvest and 5 year harvest did not occur significant. The yield is not decreasing after 2 harvests.

The yield of poplar is to be looked up in table 1.

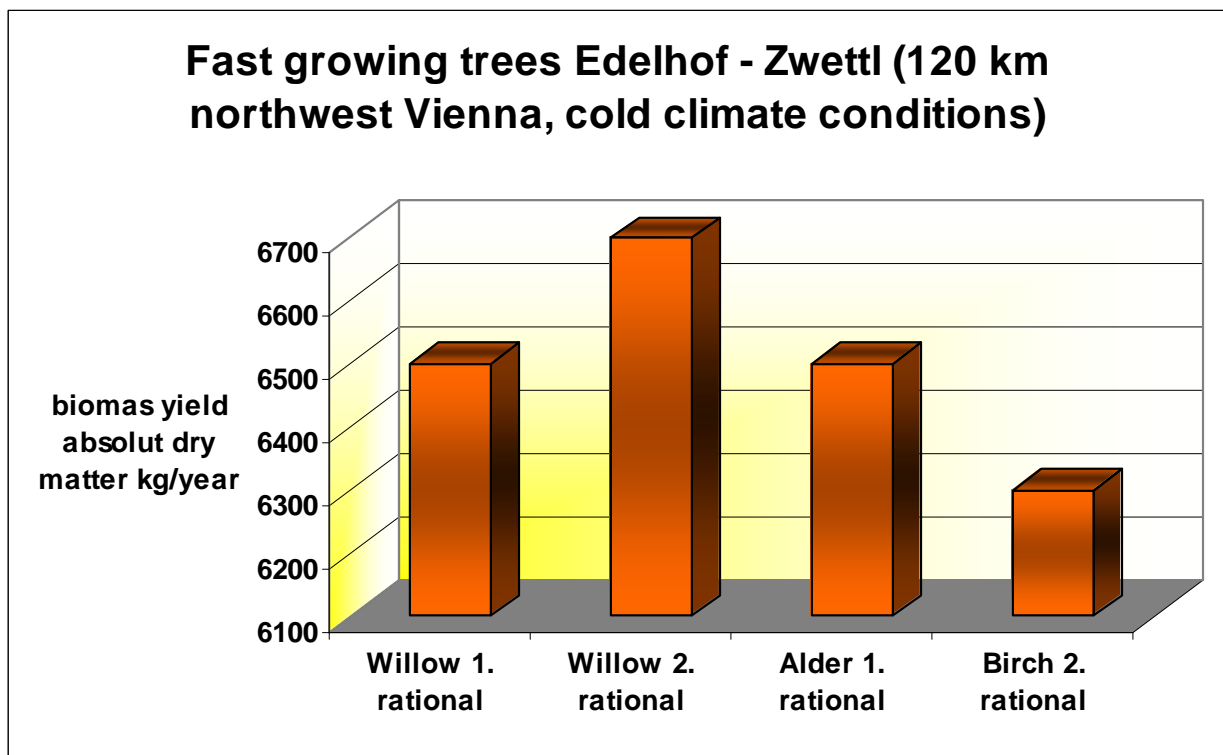
Table 1: Yield Poplar Amstetten 1996 - 2006

	variety	
harvest every 3 years.....	Jap 105.....	1.700 kg/ha/year dry matter
harvest every 5 years.....		1.100 kg/ha/year
harvest every 3 years.....	Panonia.....	5.900 kg/ha/year dry matter
harvest every 5 years.....		5.100 kg/ha/year

Poplar has definitely not the high potential of willow in this test, but the varieties of willow are hybrids, the poplar varieties are conventional and are descended from natural selection.

In these test plots the biggest risk for the willow trees is the immigration by *Clematis vitalba*, which is complicated to control by herbicides. *Clematis* grows very fast and covers the culture of willow and poplar – in winter the trees break under a snow cover and are damaged. An early control with Basta (Glyphosinate) is inevitable, an under leaf application of this substance is tolerant to the culture – plant.

Fast growing trees were also tested in the Waldviertel, an area 120 km Northwest from Vienna with a cold climate, special very cold winter are usual. In graph 2 the results are demonstrated.



Graph 2 shows, that willow is superior alder and birch. Willow is treated by breeders in the last decades – hybrids are created; alder and birch are naturally and not

treated, so they have no potential for high yields. Another challenge is the weed control after planting the cuttings. In the youth stage the small plants are tender to the competition of weeds, which makes an effective weed control necessary. In the next table the herbicide test 2007 is described. In table 2 are the common names, the appointment, the active substance, the application rate and the control in % of the emergent weeds and the phytotoxicity noticed.

Table 2: herbicide test 2007 dry area – Phytotoxicity with and without irrigation

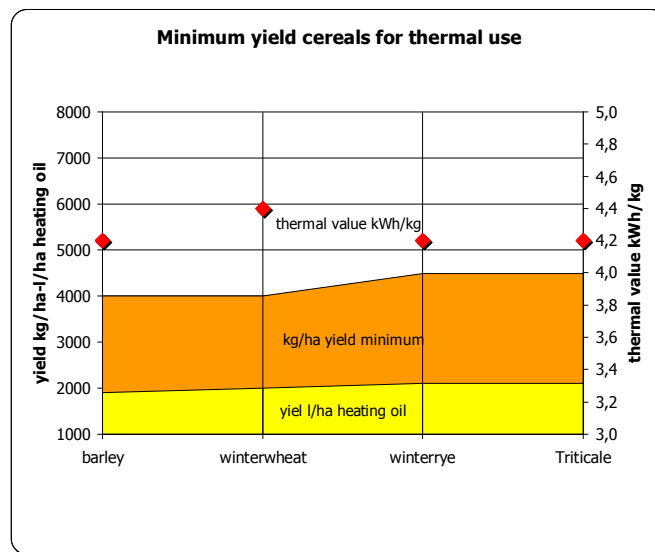
Herbicide	appointment	active substance	application rate	efficiency of herbicide effect %			Phyto toxicity		1 no Phytotox
					Lamium	Amaranthus	Echinochloa	1 to 9	9 total
					amplexicaule	retroflexus	crus galli	Willow	Poplar perishing
Nozomi	pre emergency	Flumioxazin	1.2 kg	98	100	62	1	1	
Flexidor	pre emergency	Isoxaben	1.0 kg	54	33	57	1	1	
Callisto	pre emergency	Mesotrione	1.5 kg	92	22	25	1	1	
Chikara +	pre emergency	Flazasulfuron	0.2 kg	88	75	88	1	1	
Break Thru		adjuvant	0.3 l						
Chikara +	pre emergency	Flazasulfuron	0.15 kg	80	72	83	1	1	
Break Thru		adjuvant	0.3 l						
Bacara	BBCH 14	Diflufenican +		100	68	50	3	4	
		Flurtamone	1 l						
Lontrel	BBCH 25	Clopyralid	1.2 l	33	22	28	1	1	
BAS 65903	pre emergency	nn	4 l	50	22	52	1	1	
Stomp CS	pre emergency	Pendimethalin	4.4 l	78	47	78	1	1	
Goltix SC +	pre emergency	Metamitron	2.5 l						
Goltix SC	BBCH 14	Metamitron	2.5 l	88	58	52	1	2	
Stomp CS +	pre emergency	Pendimethalin	3 l						
Aramo	BBCH 25	Tepralxydim	2 kg	77	63	100	1	1	

The herbicide test was not irrigated, the conditions after application were dry, and so the residual herbicides had not reached their full activity. The test will be repeated next year.

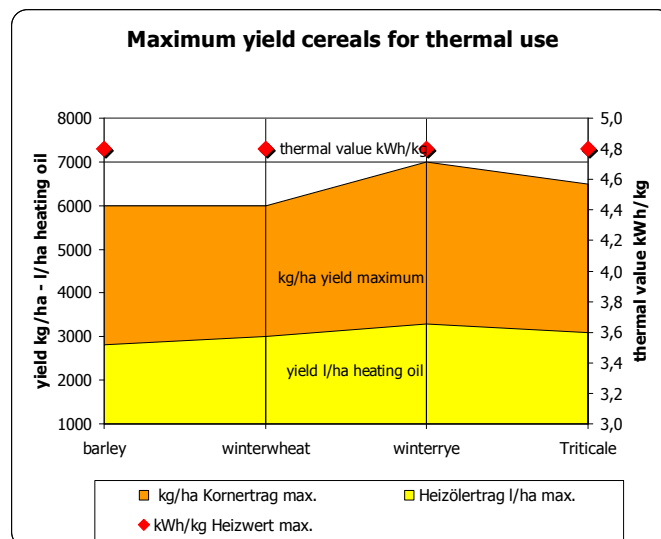
The best efficiency of herbicide showed Chicara (Flazasulfuron + Adjuvant), this product had a good tolerance to the cultivated plants (willow and polar). Baccara (Diflufenican + Flurtamone), used this year in Austria, had a middling efficiency of herbicide but phytotoxic indications on leaves, which disappeared 3 months after application, no influence to the yield is expected.

Energy grain for combustion is also tested in Lower Austria. A Cereal yield of 6.000 kg per ha corresponds to 2.500 l heating oil. Good yields corresponds to more than 3.000 l heating oil. The thermal values of cereals are 4.4 – 4.8 kWh/kg (graph 3 and 4)

Graph 3:



Graph 4:



The heatings are more or less tested; the NO_x in the exhaust gases is solved for the most part.

The protein content depends much more from the year – weather conditions – than from the agricultural measure. Rye has the lowest protein content and in that case the lowest NO_x output in the exhaust.

Austria has reported 480 ha for energy cereals. 250 boilers are reported for energy cereals in Lower Austria. 1.700 boilers for renewable energy are at work.

Conclusion

Austria is a pioneer in renewable energy. Fast growing trees are tested since 1996 on a location in the western part of Lower Austria. The yields are successful, willow is superior poplar. The reason is that the tested varieties of willow are hybrids, poplar has only natural selection. In the test plots, started 2006, willow and poplar varieties are hybrids. Willow comes from Sweden, Poplar from Italy (Po valley). Alder and birch are possible alternatives, but not yet treated by breeders.

Fast growing trees are tender to the competition of weeds in youth stage. This makes an efficient weed control necessary. Herbicide tests stated 2007, the results show big differences in the mainly residual herbicides. The dry weather conditions 2007 are to be mentioned, future tests are planned.

The harvest is solved, double chop harvesters are used. A recultivation after 15 – 20 years with a rotary cultivator (rotary brushwood chopper) changes back to arable land.

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