

Potential of short rotation woody energy crops for solid biofuel production in Latvia

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Background information

Topical issues become not only production of solid woody biofuel in plantations, but also utilization of organic wastes, including wastewater sludge. The aim of the studies summarized in this dissertation is to solve both of these problems simultaneously by using of the wastewater sludge as a fertilizer in short rotation willow plantations thus increasing a productivity of the plantations. Current conditions in Latvia promote increasing use of energy wood and establishment as well as utilization of biodegradable waste containing plant nutrients in the short rotation plantations.



Research overall objective

To elaborate ecologically and economically grounded model for utilization of the wastewater sludge in the short rotation willow plantations by estimation of productivity of the plantations in different soils and under different growing conditions, by evaluation of environmental effects of the sludge applications, by providing of solutions for environmentally safe utilization of the sludge and by estimation of economical effect of applications of this fertilizer, according to the requirements of the EC Directives.

Research tasks and experiment

- To estimate changes of soil properties depending from intensity of the sludge applications and plantation management technology.
- To evaluate suitability of different soils, fertilizer applications and planting material for establishment of the short rotation plantations in Latvian conditions and to check suitability of Swedish willow planting material to the Latvian conditions.
- To evaluate possibilities to increase productivity of the short rotation plantations and to provide economical evaluation of the proposed model.

Variants of fertilization trials

Planting site, year of planting	Code	Fertilizer	Application of fertilizer
Virši, 2005 used peat quarry (peat layer >80cm)	VD	wastewater sewage sludge 10 t _{DM} ha ⁻¹	2005 06
	VDD	wastewater sewage sludge 10 t _{DM} ha ⁻¹	2005 06
		dolomite 10 t ha ⁻¹	2006 05
	VK	control	control
	VKD	dolomite 10 t ha ⁻¹	2006 05
	VM	minerals 0.5 t N ha ⁻¹	2005 05
	VMD	minerals 0.5 t N ha ⁻¹	2005 06
		dolomite 10 t ha ⁻¹	2006 05
Mārupe, 2005 bare mineralsoil	MD	wastewater sewage sludge 10 t _{DM} ha ⁻¹	2005 05
	MK	control	control
Olaine, 2004 light mineralsoil	OD ₂₀₀₄	wastewater sewage sludge 10 t _{DM} ha ⁻¹	2005 04
Olaine, 2006 light mineralsoil	OD ₂₀₀₆	wastewater sewage sludge 10 t _{DM} ha ⁻¹	2007 04

Factors limiting establishment of willow plantations are insufficient knowledge and lack of experience in:

- environmental effect of wastewater sludge applications;
- suitable species for Latvian conditions;
- technologies of establishment and management of plantations.

Research and results

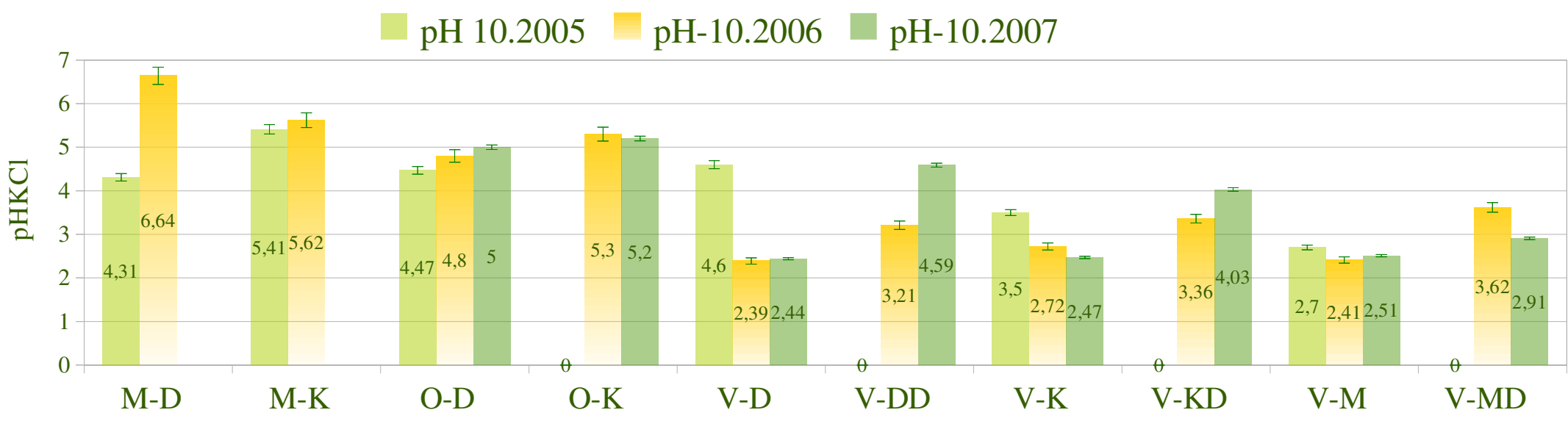
The dissertation thesis and other informative materials as well project summaries are available on Latvia State Forest Research institute “Silava” website www.silava.lv

Main findings

Effects of wastewater sludge applications:

- additional organic material as well as significant amount of nutrients (N, P, Ca and Mg) is applied to mineral soils improving fertility and water regime;
- reserves of phosphorus significantly increases in peat soil, providing favourable conditions for natural afforestation and development of ground vegetation on peat soil;
- fertilizer applications improves productivity and, consequently, feasibility of plantations;
- fertilizers don't degrade environmental conditions (concentration of heavy metals in soil changes insignificantly, no leaching of nutrients into deeper soil layers detected).

Wastewater sludge has comparably small liming effect. Fertilizing effect of sludge can be increased by admixture of wood ash and dolomite. These materials reduces acidity of soil and provides additional nutrients. Use dolomite as a liming material, dose 10 t ha⁻¹, secures change of pH by 0.6...1.2 units in peat soil. Significant changes of pH found only in few centimetres deep upper layer of soil. Application of equal dose of wood ash provides faster effect of neutralization.



Following productivity measures are estimated – varieties Tora and Torhild, which are recognized within the scope of this study as the most promising in Latvia conditions, in 2-3 years rotation cycle produces 28...32 tdry.

Variety	Age	Number of shoots per ha	Number of shoots from cutting	DBH, cm	H, m	Stock, t _{DM} *h ^{el}
Sven	2	65.2	4.3	0.9	2.6	5.8
Sven	3	51.2	3.4	1.4	3.7	12.4
Tora	2	70	4.7	1.7	4.2	32.3
Tora	3	51.6	3.4	1.9	5.2	31.0
Torhild	2	91.6	6.1	1.2	4.3	18.4
Torhild	3	61.2	4.1	1.7	4.6	27.5
S.viminalis clone	3	102.4	8.5	1	3	11.6

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