Waste water sludge for re-cultivation of degraded areas and forest health improvement

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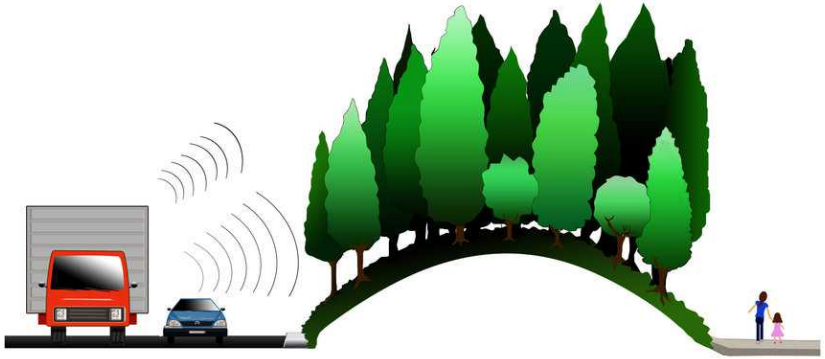

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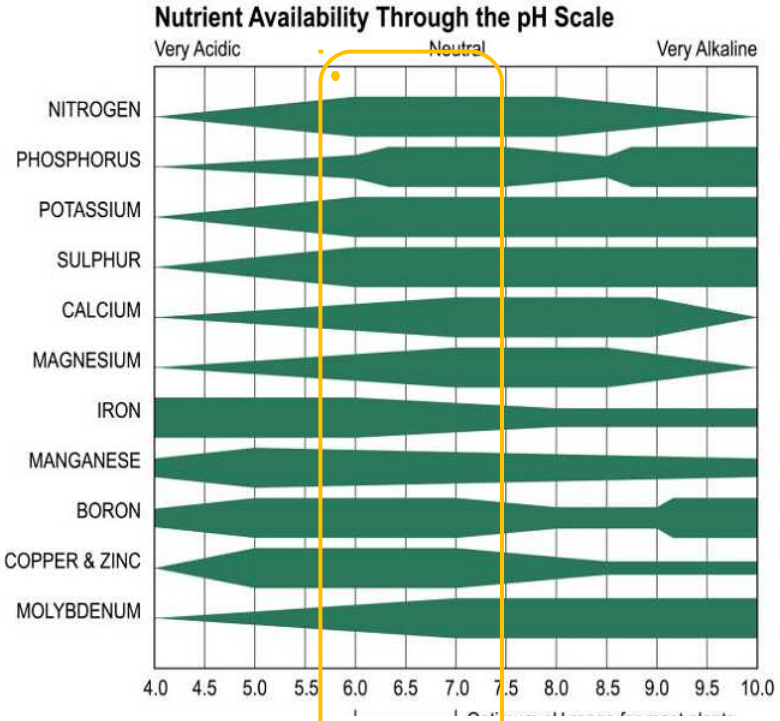
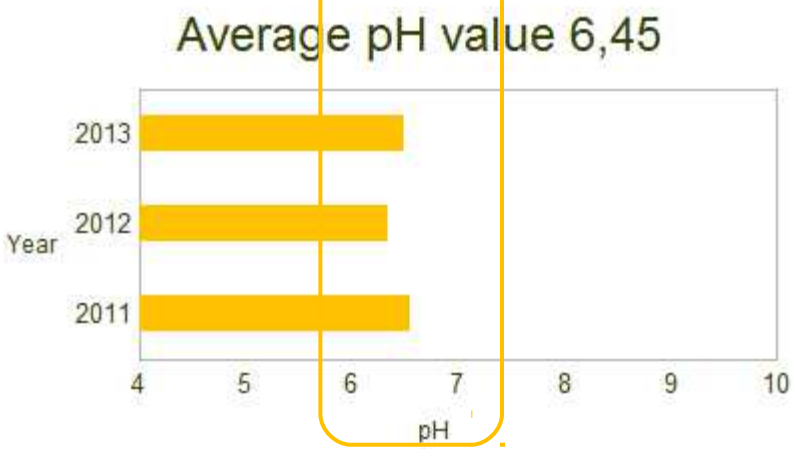
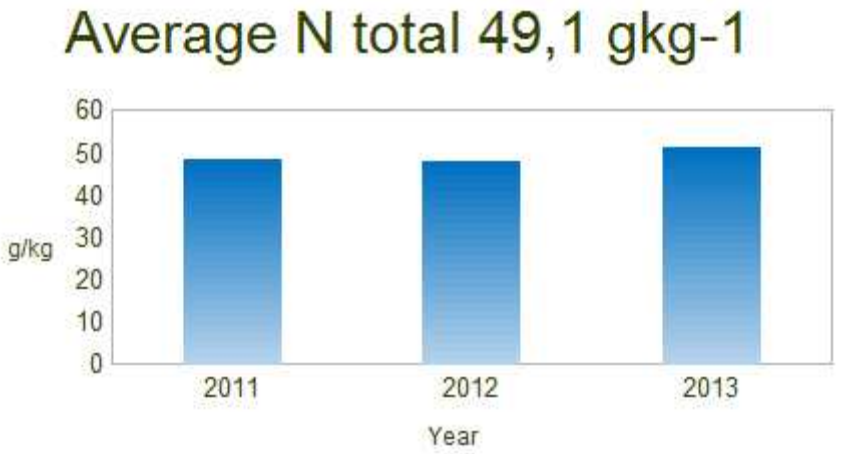
Is waste water sludge = waste? NO!







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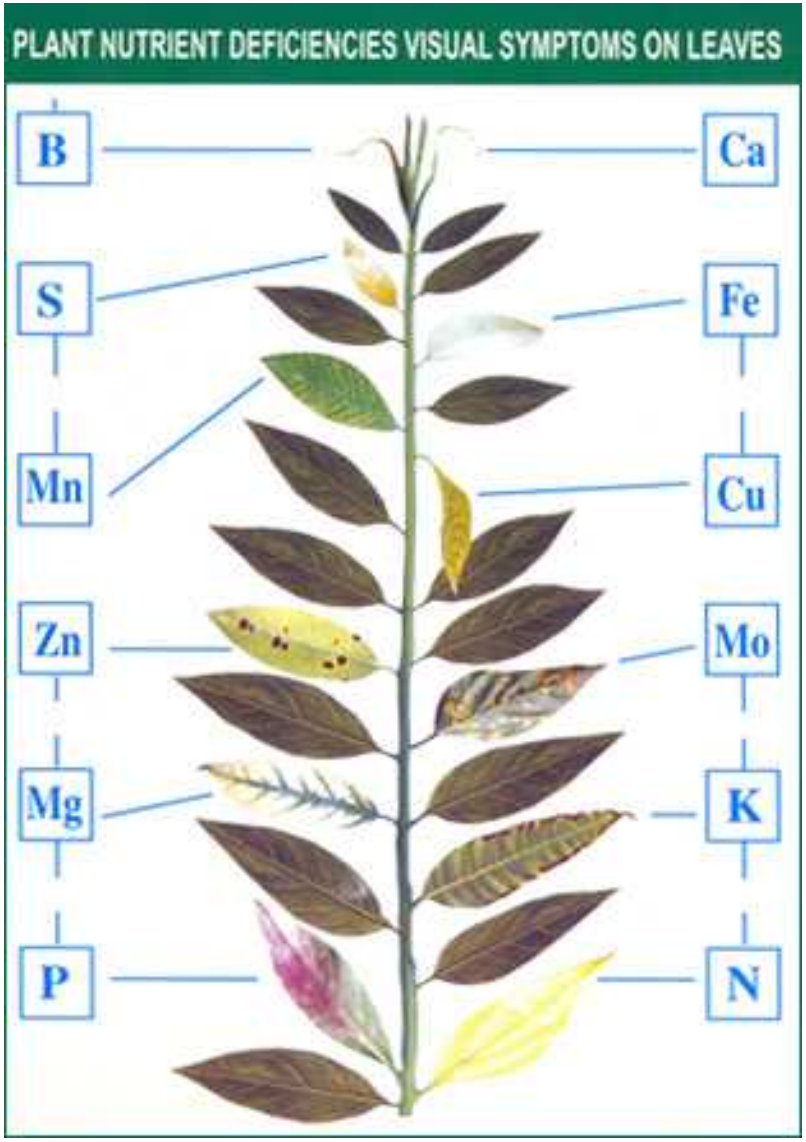
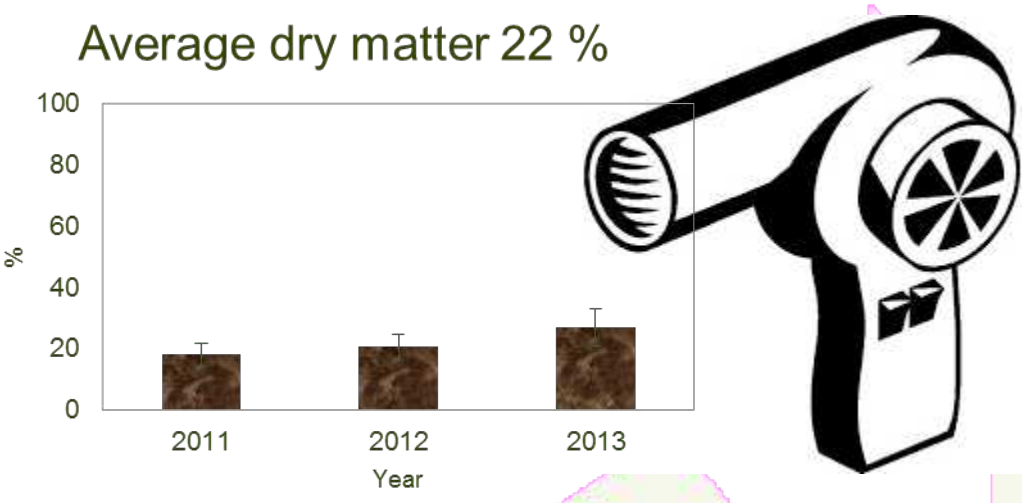
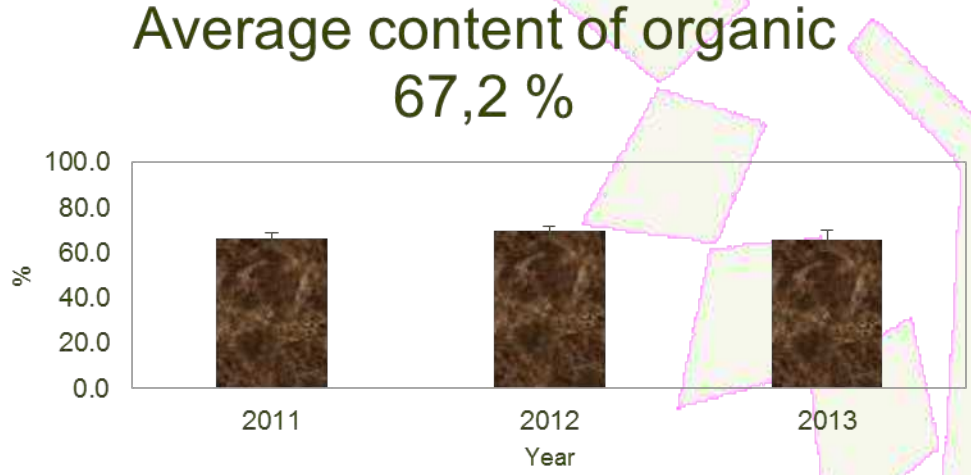
Waste water sludge = deposit of plant nutrient elements



http://eurocol.in/euroagri/micro-nutrients.html





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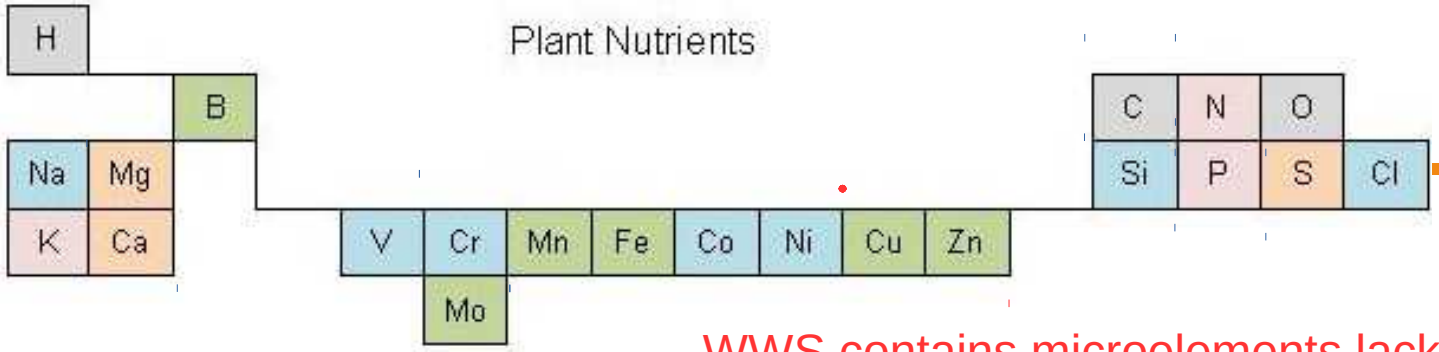

WWS contains microelements lacking in Latvia soils - Cu, Zn and B

Organic		Major		Secondary		Micronutrients		Functional	
C	Carbon	N	Nitrogen	Mg	Magnesium	B	Boron	Na	Sodium
H	Hydrogen	P	Phosphorus	Ca	Calcium	Cu	Copper	V	Vanadium
O	Oxygen	K	Potassium	S	Sulphur	Fe	Iron	Co	Cobalt
						Mn	Manganese	Si	Silicon
						Mo	Molybdenum	Cl	Chlorine
						Zn	Zinc		

	Concentration of heavy metals in dry matter (mg/kg)						
Quality class of WWS	Cd	Cr	Cu	Hg	Ni	Pb	Zn
I	<2	<100	<400	<3	<50	< 150	< 800
II	2,1-5,0	101-250	401-500	3,1-5,0	51-100	151-250	801-1500
III	5,1-7,0	251-400	501-600	5,1-7,0	101-150	251-350	1501-2200
IV	7,1-10	401-600	601-800	7,1-10	151-200	351-500	2201-2500
V	>10	>600	> 800	>10	> 200	> 500	> 2500
2011	1,72	60,19	173,20	1,67	20,42	38,82	685,24
2012	1,20	55,34	175,05	1,78	25,38	37,14	632,74
2013	1,00	83,76	214,60	1,74	26,62	33,23	765,28
Total Result	1,32	65,83	186,68	1,73	24,05	36,51	691,97

Trees on degraded areas – bare sand

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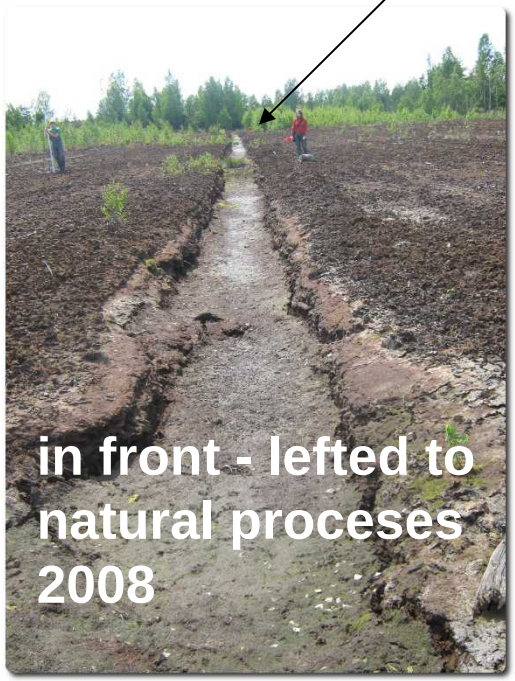
Trees on degraded areas – former peat mining areas



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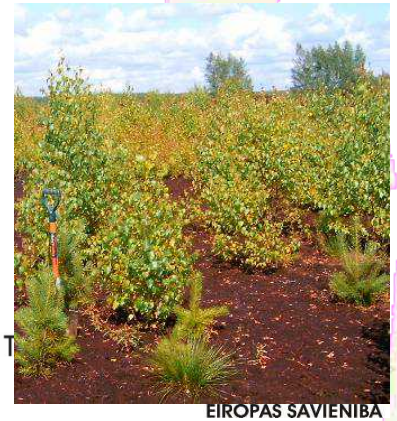
Experiment estasblished 2006

Treatment	First year	Second year	Third year
Control			
Waste water sludge			
Mineral fertilizers			

Fourth season - summer

Control – unfertilized

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After six years

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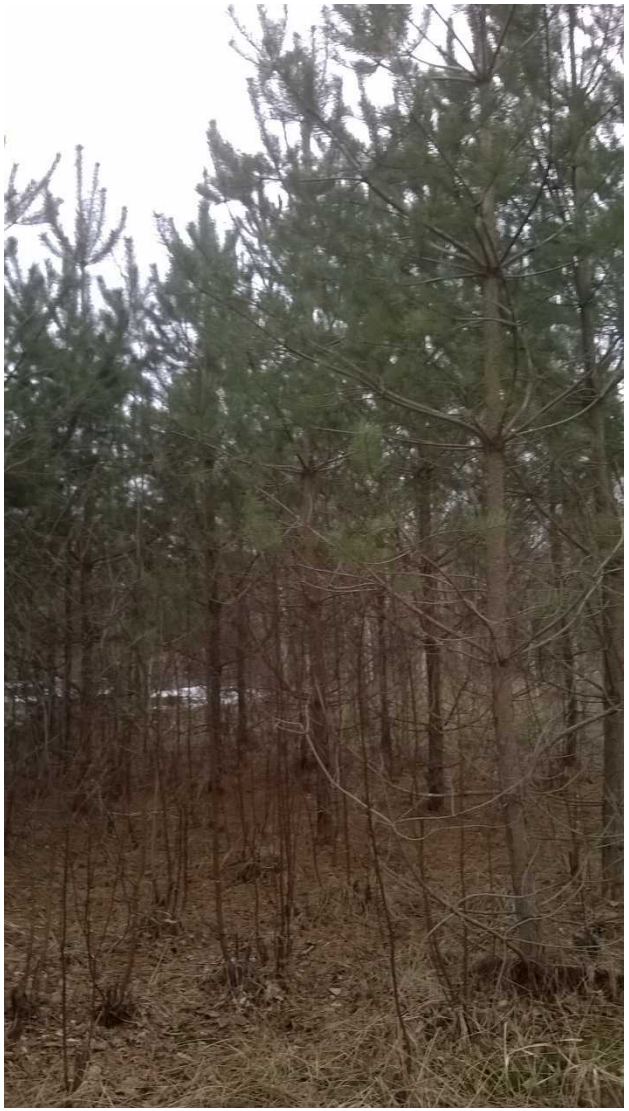
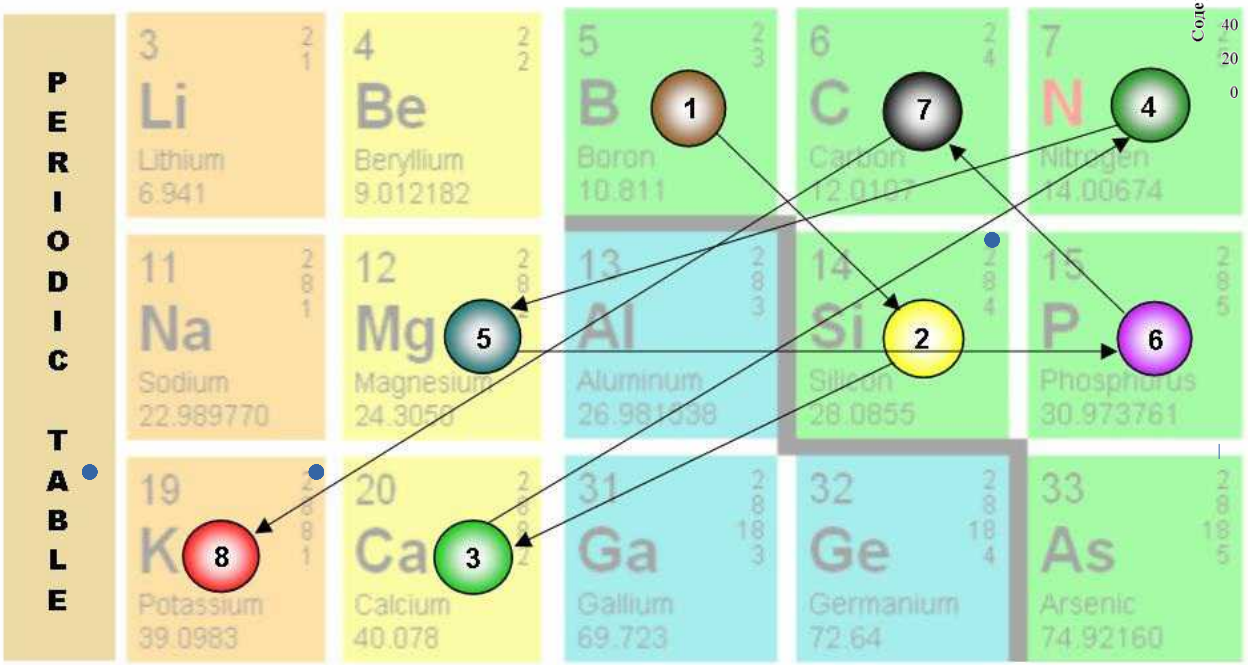
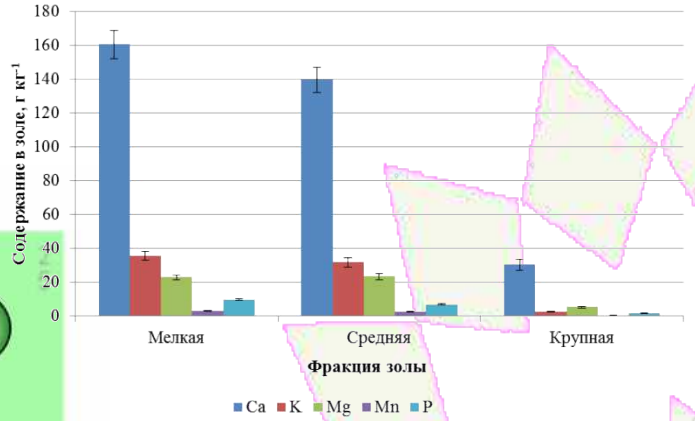
Productivity



Wood ash – for liming or fertilization?





Plant biochemical sequences begin with:

1. ***Boron***, which activates →
2. ***Silicon*** which carries all other nutrients starting with →
3. ***Calcium*** which binds →
4. ***Nitrogen*** to form amino acids, DNA and cell division.

Amino acids form proteins such as chlorophyll and tag trace elements, especially →

5. ***Magnesium*** which transfers-energy via →
6. ***Phosphorus*** to →
7. ***Carbon*** to form sugars which go where →
8. ***Potassium*** carries them. This is the basis of plant growth.

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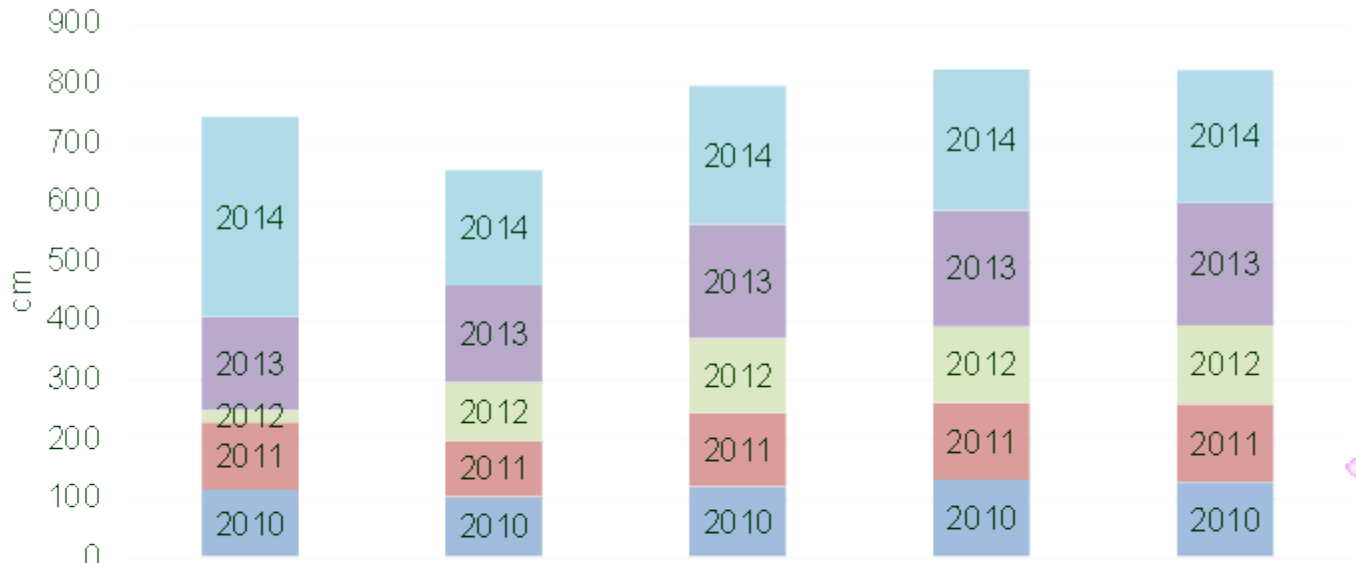
Fertilizers

Fertilizer	**N, kg ha^{-1}**	**P, kg ha^{-1}**	**K, kg ha^{-1}**
Wood ash 3 t_{od} ha^{-1}	0.7	**19.3**	**164.7**
Waste water sludge 10 t_{od} ha^{-1}	324.80	136.00	19.60
1,5 t_{od} ha^{-1} wood ash + sludge 5 t_{od} ha^{-1}	**162.75**	**77.65**	**92.15**
Biogass production residue 30 t ha	9.75	**19.00**	70.00
Optimum	***100-200***	***20-40***	***100-200***




Wood ash and waste water sludge mixture



	control	biogass production residues	wood ash	wood ash & WWS	WWS
2014	339	196	234	239	225
2013	158	164	192	196	206
2012	20	99	126	128	132
2011	114	93	124	130	132
2010	114	103	120	131	126

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Amounts of main nutrients applied by fertilisers in plantations

Amount of fertiliser	N, kg ha^{-1}	P, kg ha^{-1}	K, kg ha^{-1}
wood ash 6 $t_{DM}ha^{-1}$	1.4	38.6	329.4
WWS 10 $t_{DM}ha^{-1}$	324.80	136.00	19.60
optimum	100-200	20-40	100-200

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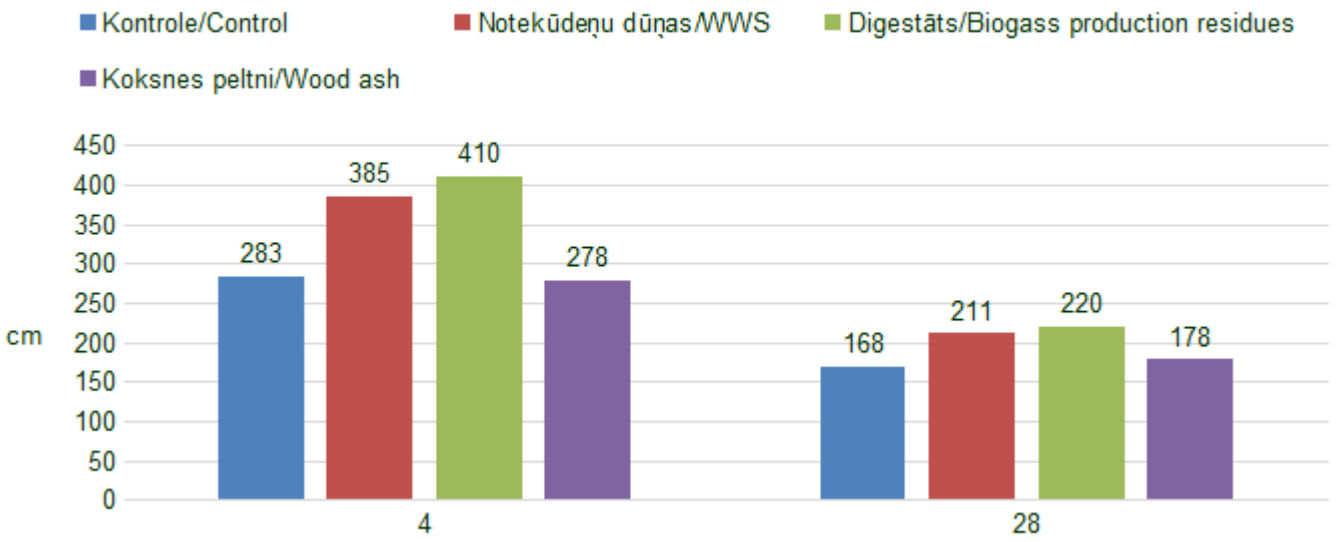
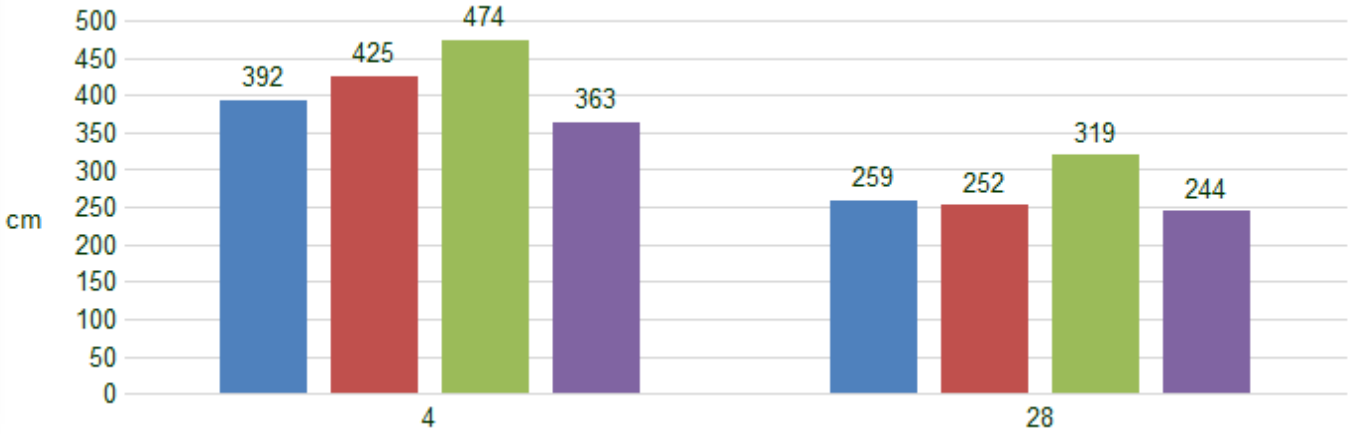
Hybrid aspen 2011-2014





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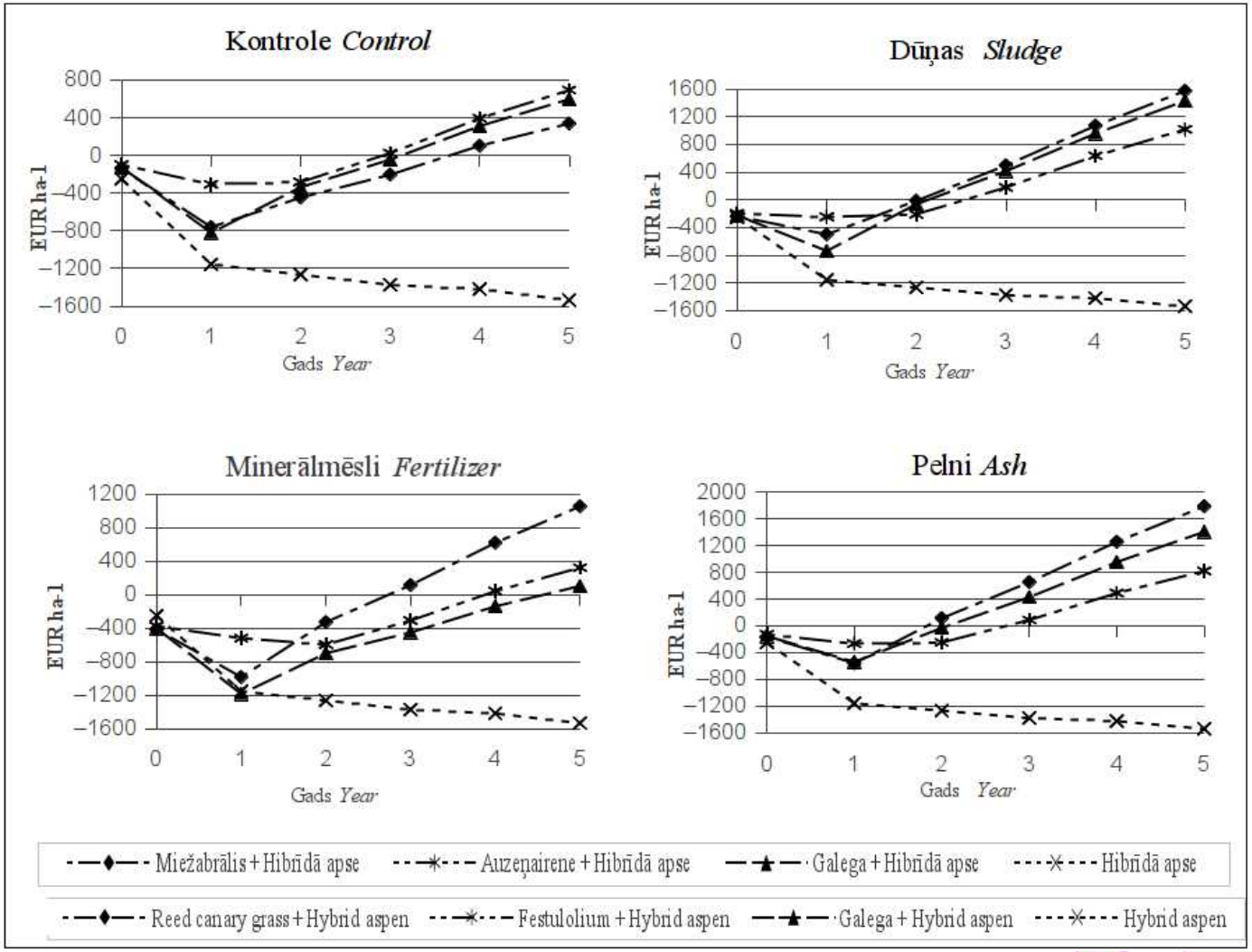
Resources to extend biomass production

(Rancane, Makovskis, Lazdina, Daugaviete, Gūtmane, Berzins. 2014, Agronomy research)

The combined growing of trees and grasses on the same area, give possibility to save costs and earn an incomes in first years, which cover starting expenses.

Reed canary grass, festulolium, and galega could be successfully grown for biomass and seed production between trees rows in the agroforestry system in Latvia. The use of different bio-energy and municipal waste products as fertilisers in general provided higher biomass and seed yields.



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Questions..

Deficiency !!!

Optimum !!!

Too much!!!

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