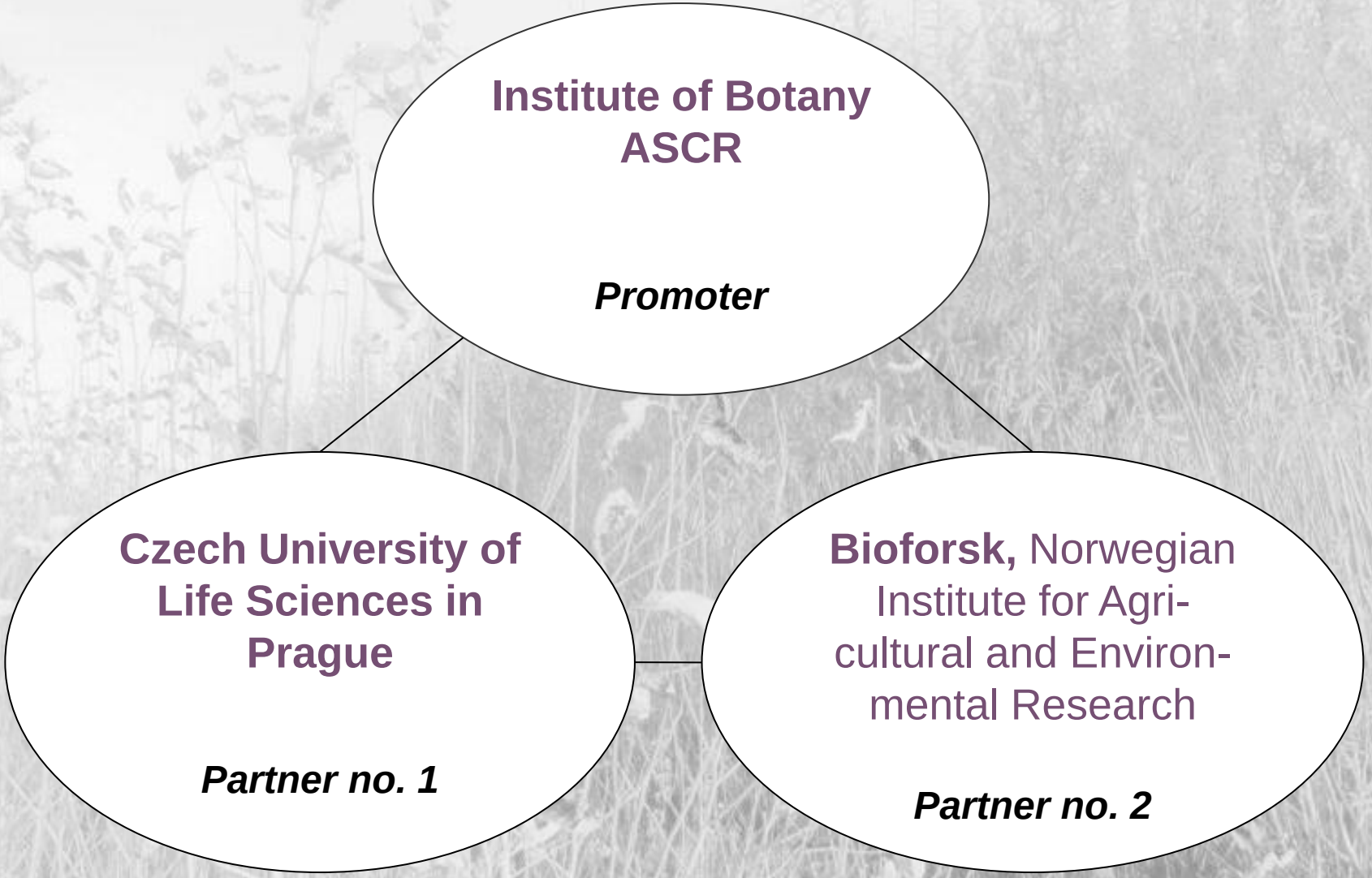
Energy plantations technology on contaminated land

2008-2011

Project CZ0092 supported by the Financial Mechanism of Norway


Institute of Botany ASCR
Promoter
Czech University of Life Sciences in Prague
Partner no. 1
Bioforsk, Norwegian Institute for Agri-cultural and Environ-mental Research
Partner no. 2

IBOT 73%

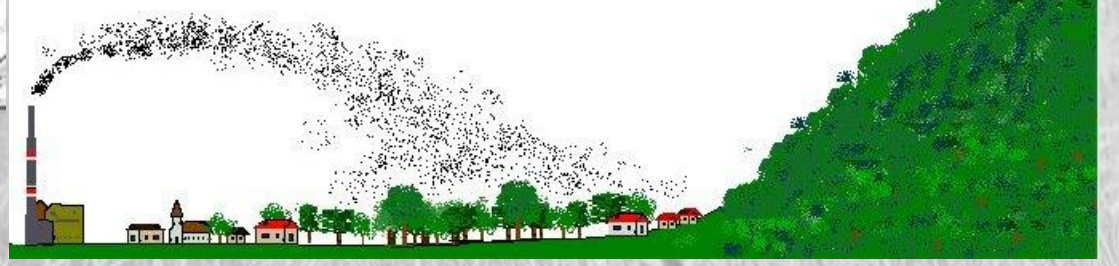
EUR 720K

CULS 15%

Bioforsk 12%

Project background

Main pollution source in the region
(hundreds of tons of Pb per year till 1982…)



Strong contamination of soils by risk elements (As, Cd, Pb, Zn)

Negative consequences on quantity and quality of agricultural production

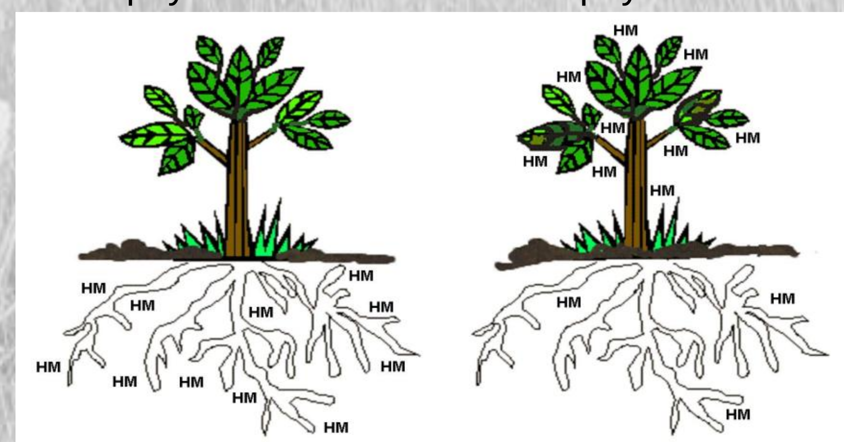
Project aims…

1) to explore potential of alternative use of contaminated land for biomass production by means of short rotation coppice plantations (SRC)
2) to reduce risks of further spread of pollutants by phytoremediation

Biomass production

phytoremediation

phytostabilization phytoextraction



Short rotation coppice plantation

Planting

Harvest

Plantation at age 3-5 y

Plantation at 1 y

Coppice outgrowth

Initial growth

Reproduced from:
FOCUS Syracuse report 2006

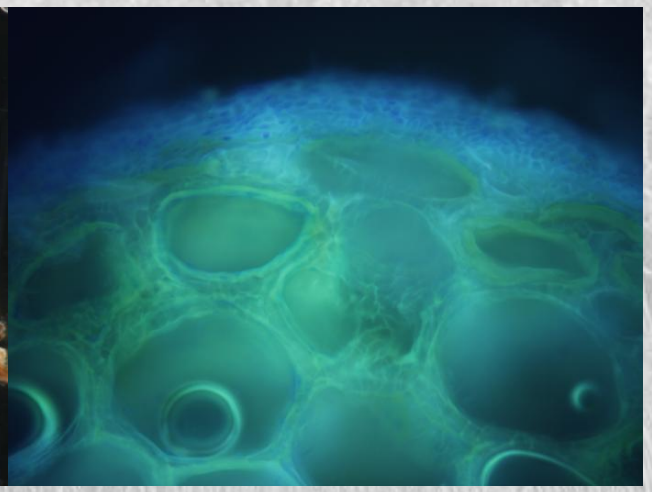
interpreter

Project levels

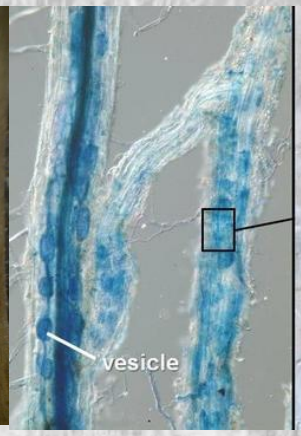
Mycorrhizal symbioses

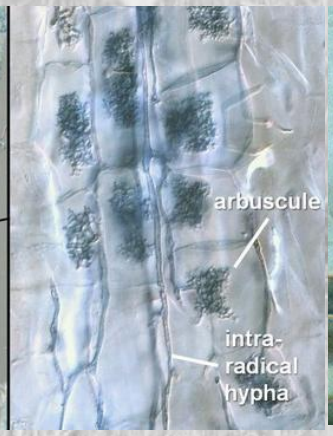
Ectomycorrhizae (ECM)





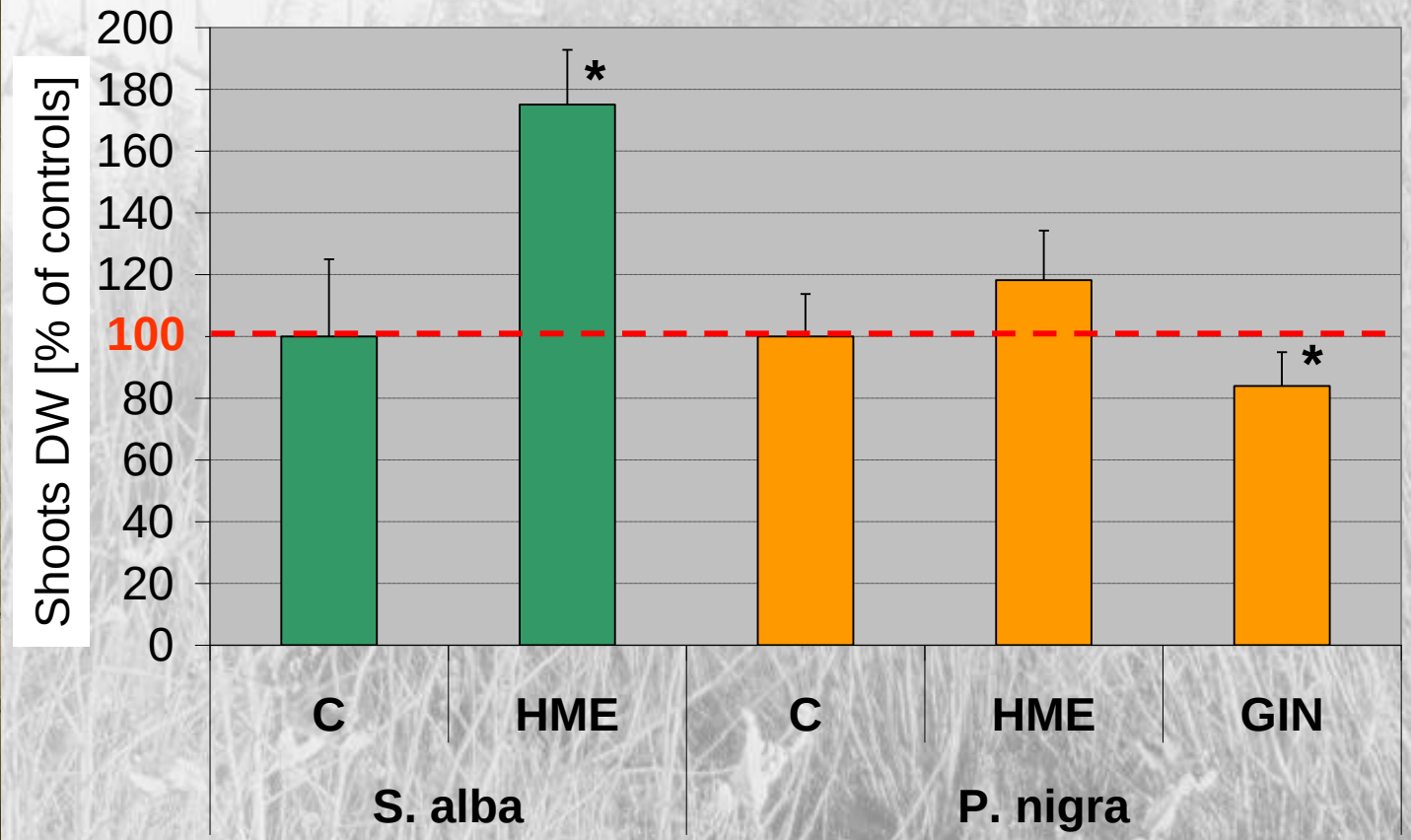
Arbuscular mykorhizae (AM)

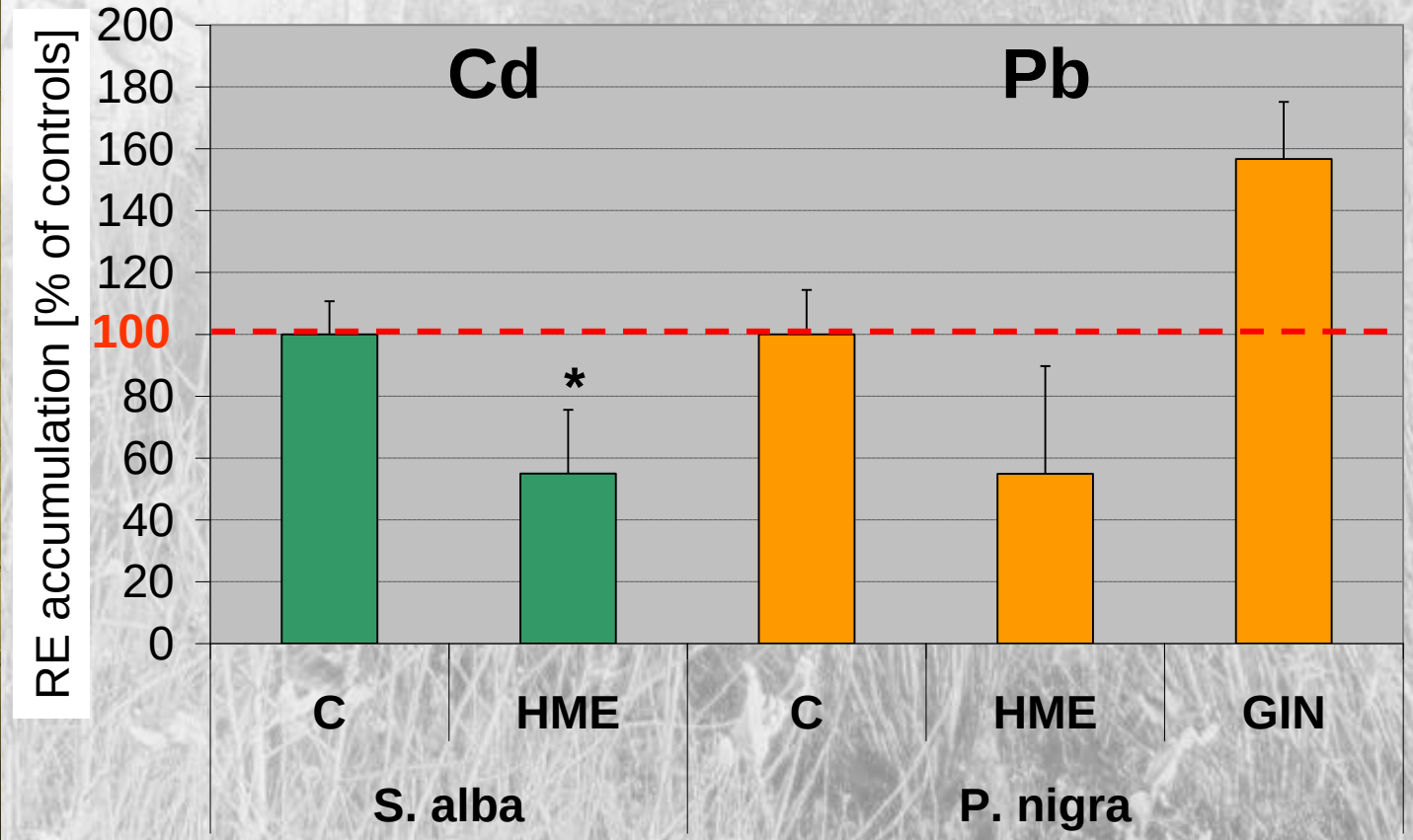


Fungal effect on growth of *Salix alba* and *Populus nigra*

HME = low accumulating, tolerant ECM fungus
GIN = tolerant AM fungus



Fungal effect on risk elements accumulation in *Salix alba* and *Populus nigra*

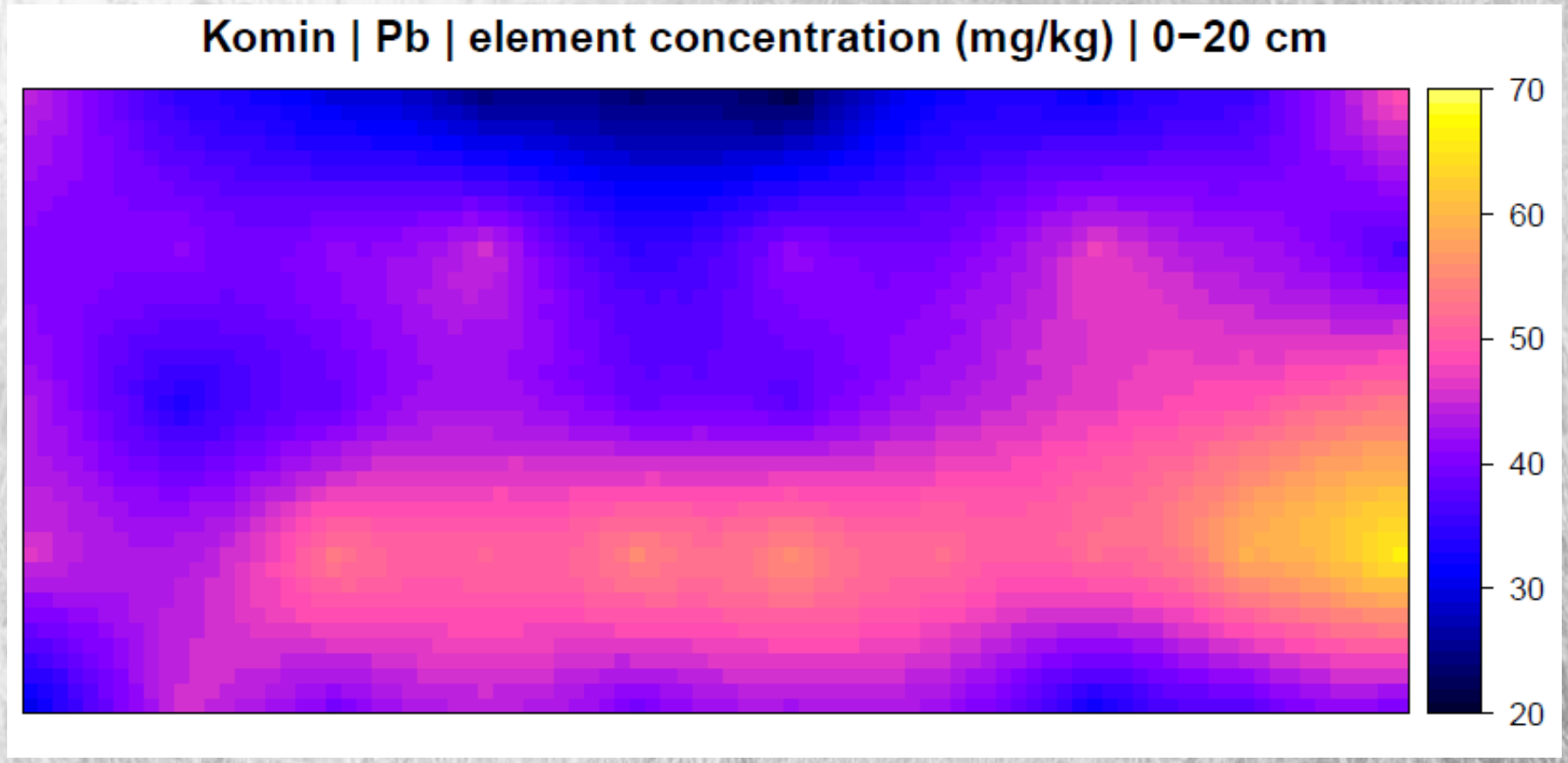


Model plantations in Příbramsko region

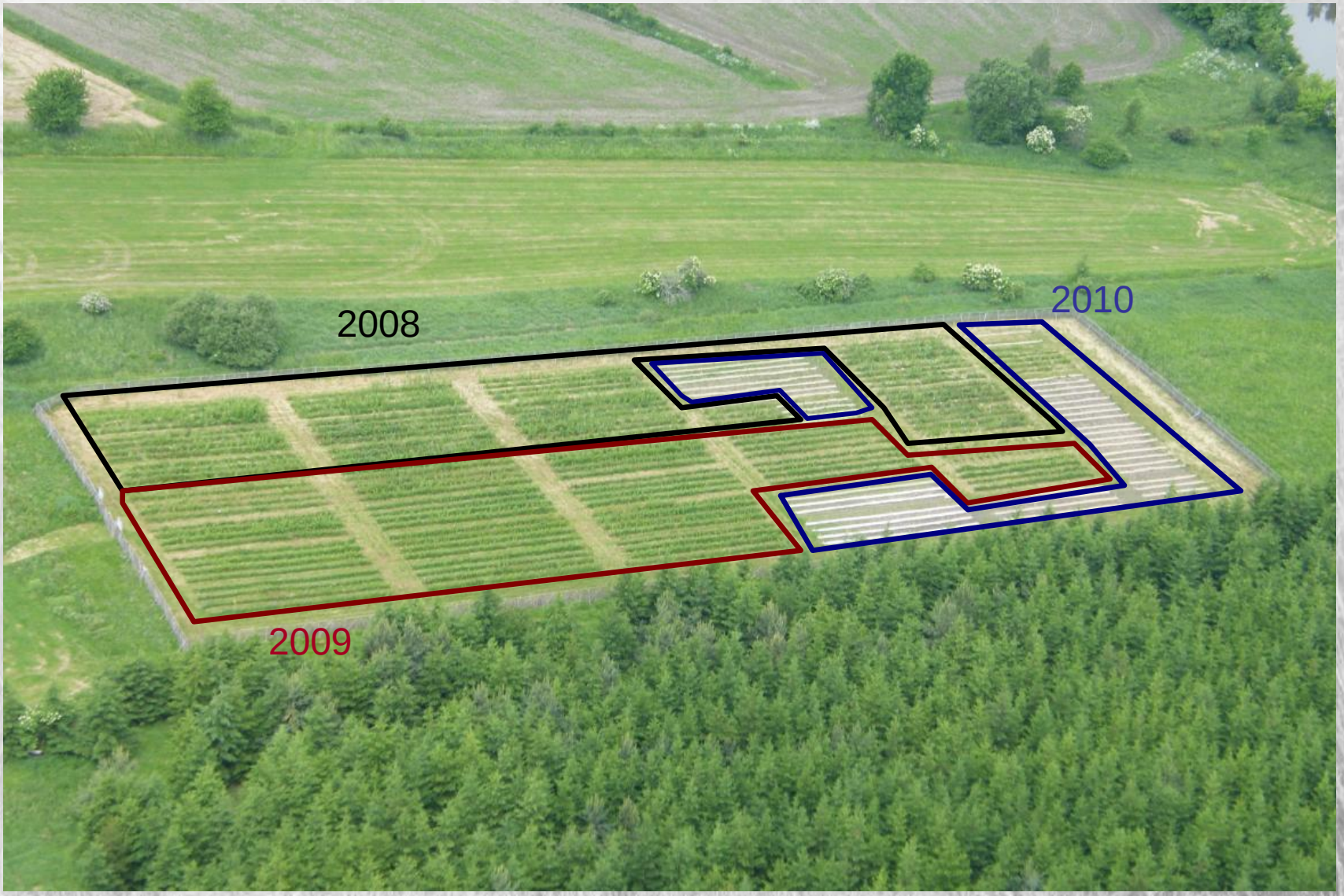
2 localities

- „Komín“ MEDIUM level of contamination
- „Litávka“ HIGH level of contamination

Heterogeneous spatial distribution of RE pollution



Plantation „Komin“ - stages



Planting 2008 at Komin plantation (medium pollution)

Experimental treatments:
Control (K) – no treatment
Fertilized (H) – 75t/ha sewage sludge (~ cca 400kg N/ha a 60kg P/ha)
Inoculated (M) – fungal mixture (4EcM,3AM), some native
Inoculated and fertilized (MH) – both M and H

Code	Clone	Sex	Origin
VB1	(*Salix viminalis* x *S. schwerinii*) x *S. viminalis* **Tordis**	female	Sweeden
VB2	*S. x smithiana* Willd. **S-218**	female	CR
TP1	*Populus nigra* L. **×** *P. maximowiczii* **Max 4**	female	Japan
TP2	*P. nigra* L. **Wolterson**	female	Netherland

Biomass production: „komín“ 2008-2010

Plantation „Litavka“

Phytoremediation efficacy

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RE quantity removed by biomass [g/ha*rok]

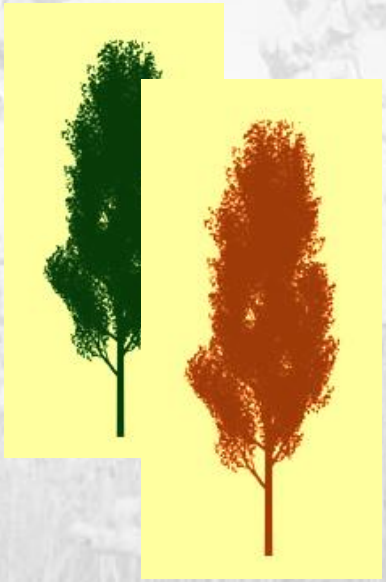
Cd 70
Pb 50
Zn 270

Cd 130
Pb 120
Zn 580

control

Fertilization +inoculation

Phytoremediation balance



After 25y:

Plantation establishment

Fertilization +inoculation

Biomass harvest + incineration

Cd 4kg/ha
Zn 20kg/ha
Pb 4kg/ha

Share of total soil RE pool

Cd ~15%
Zn ~2%
Pb ~0.1%

Incineration of contaminated biomass

??

- by filtering of flue gas **most risk elements may be removed**
- filtering by cyclone filters may not be sufficient and in moderate to high contamination levels the sleeve filters are required

Conclusions

- symbiotic fungi may modulate flow of risk elements from soil to plants

- selection of tree clones is most influential factor on biomass yield in field

- sewage sludge is convenient energy plantations fertilizer

- incineration of contaminated biomass is safe provided the efficient filtering of flue gas

- growing energy plantations on contaminated land represents feasible use of such land; however, the soil remediation is slow and inefficient

Thank you for your attention!