

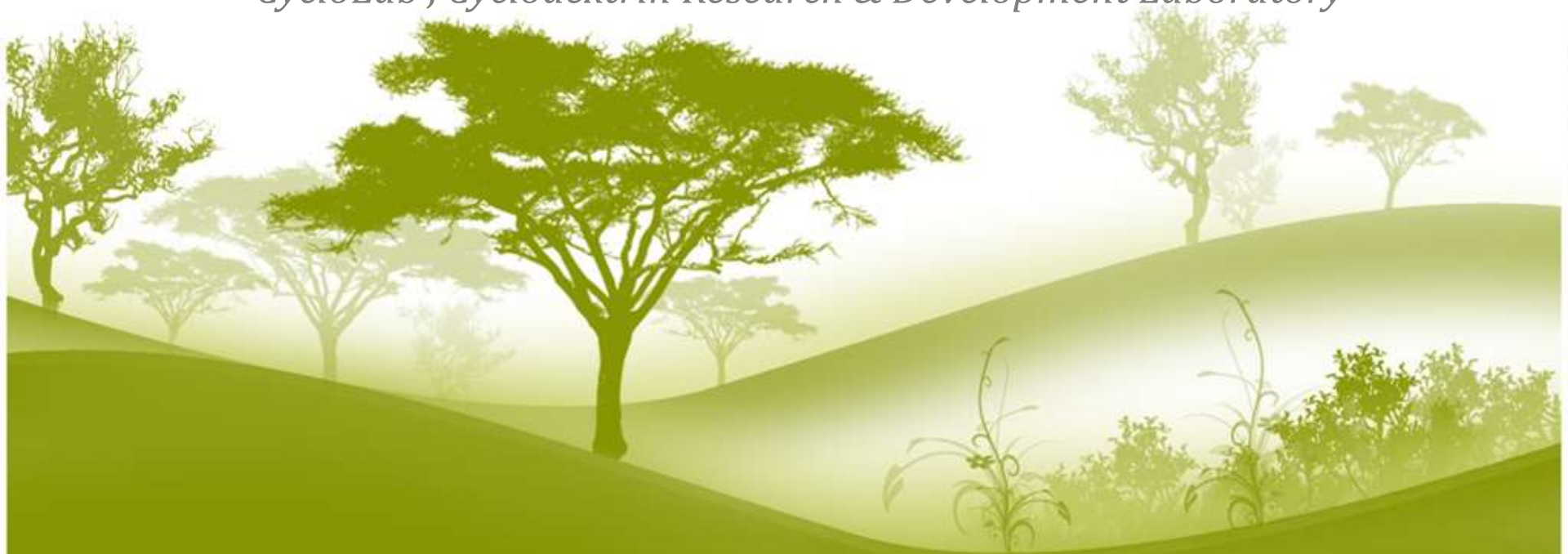
SOIL REMEDIATION AND INTEGRATED TECHNOLOGY MONITORING

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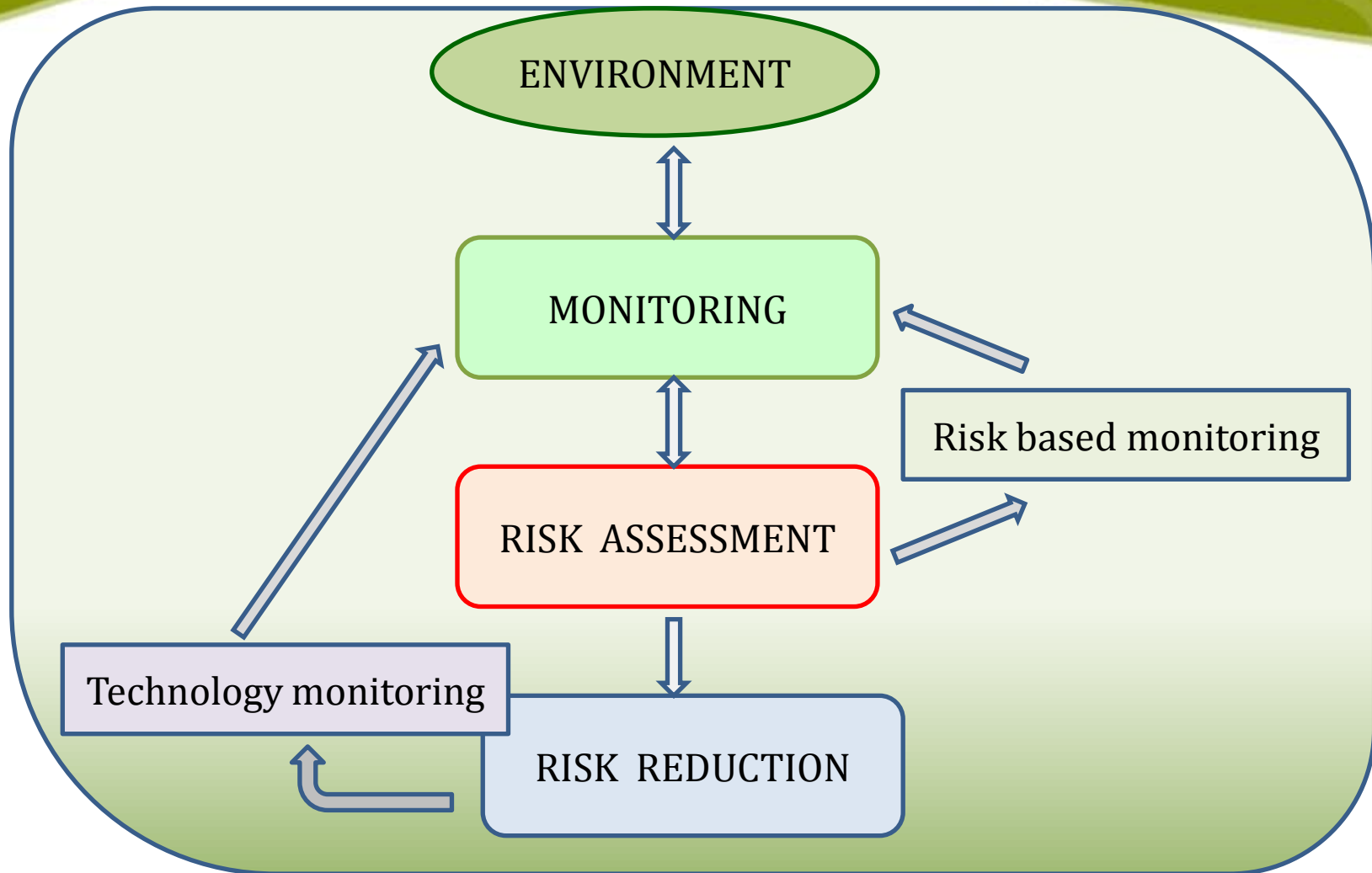
¹*Budapest University of Technology and Economics*

²*Hungarian Academy of Sciences, Centre for Agricultural Research*

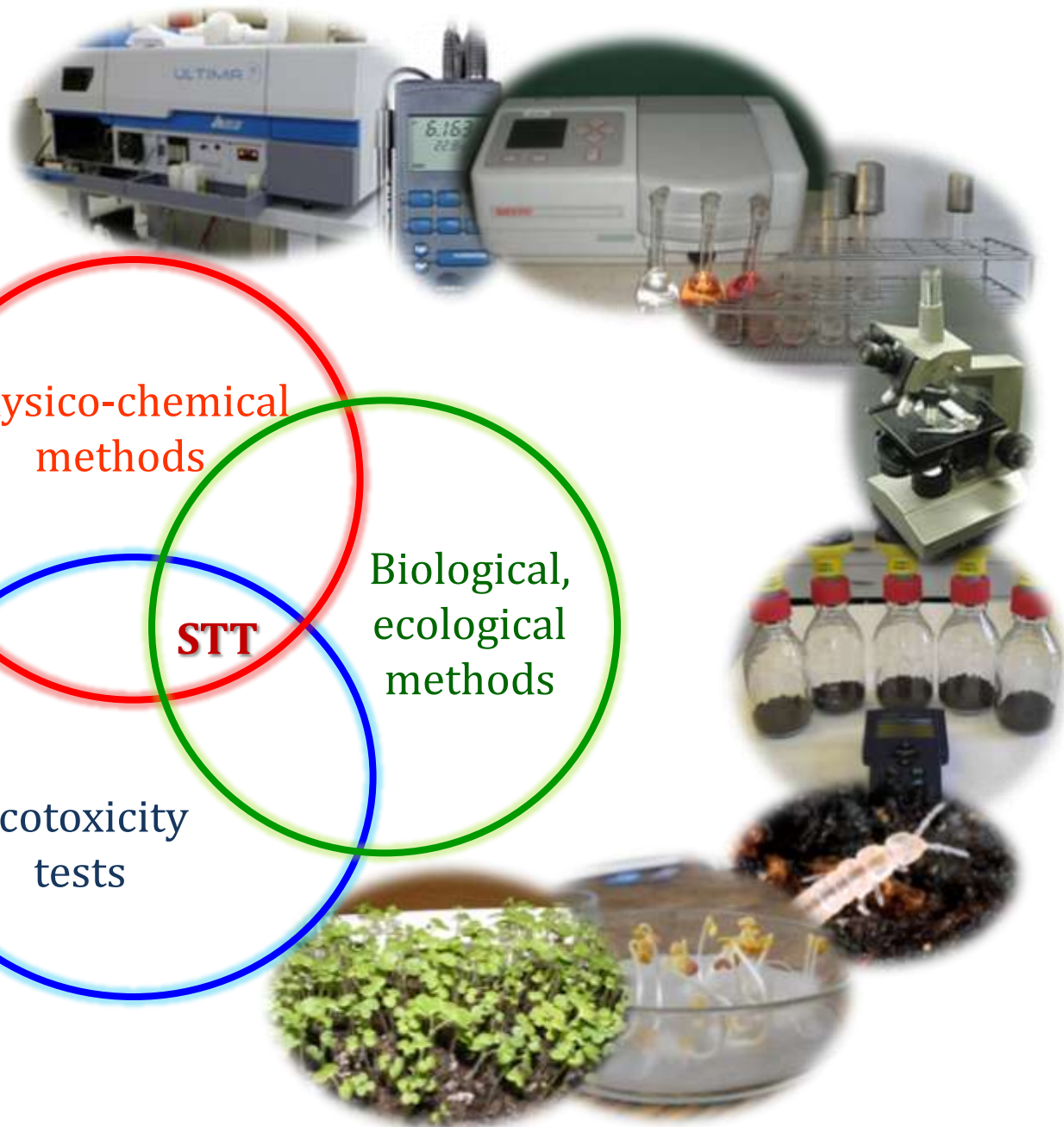
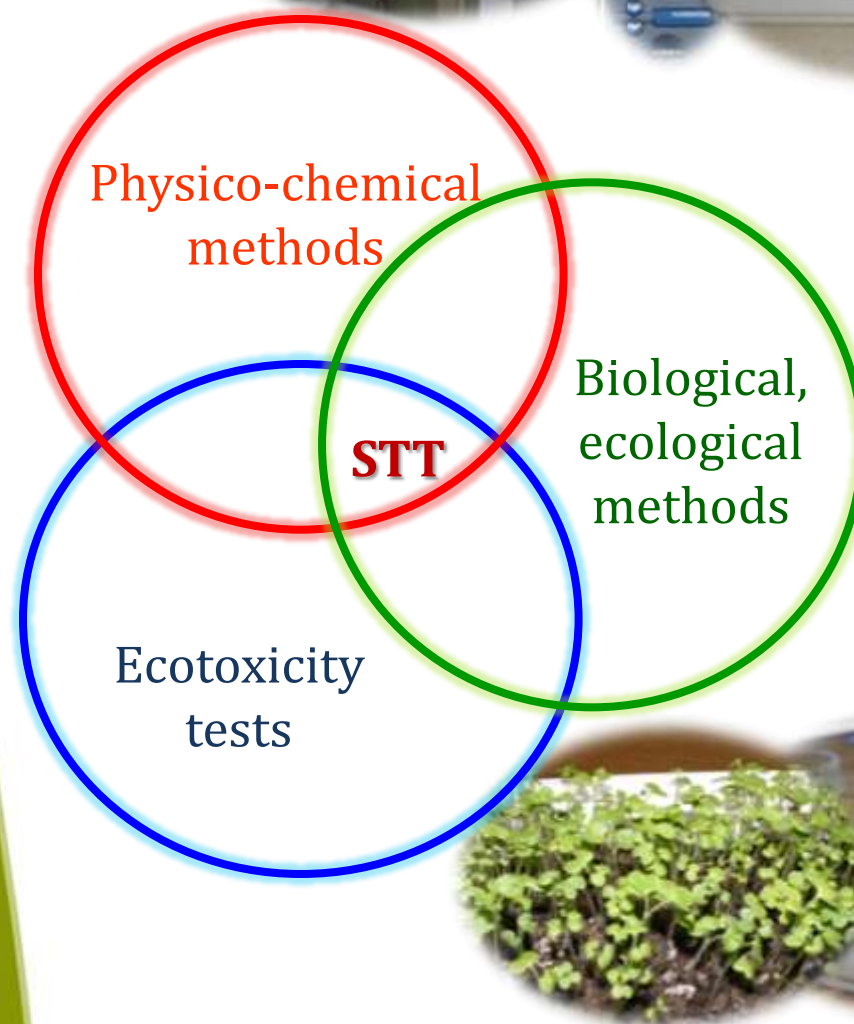
³*CycloLab , Cyclodextrin Research & Development Laboratory*



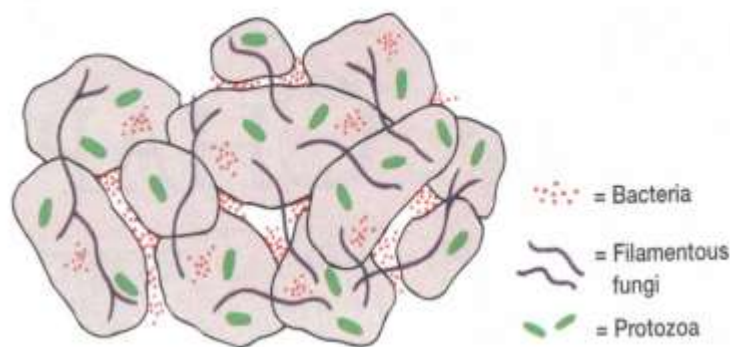
MANAGEMENT OF THE ENVIRONMENT - *ENGINEERING TOOLS*



INTEGRATED METHODOLOGY SOIL TESTING TRIAD STT

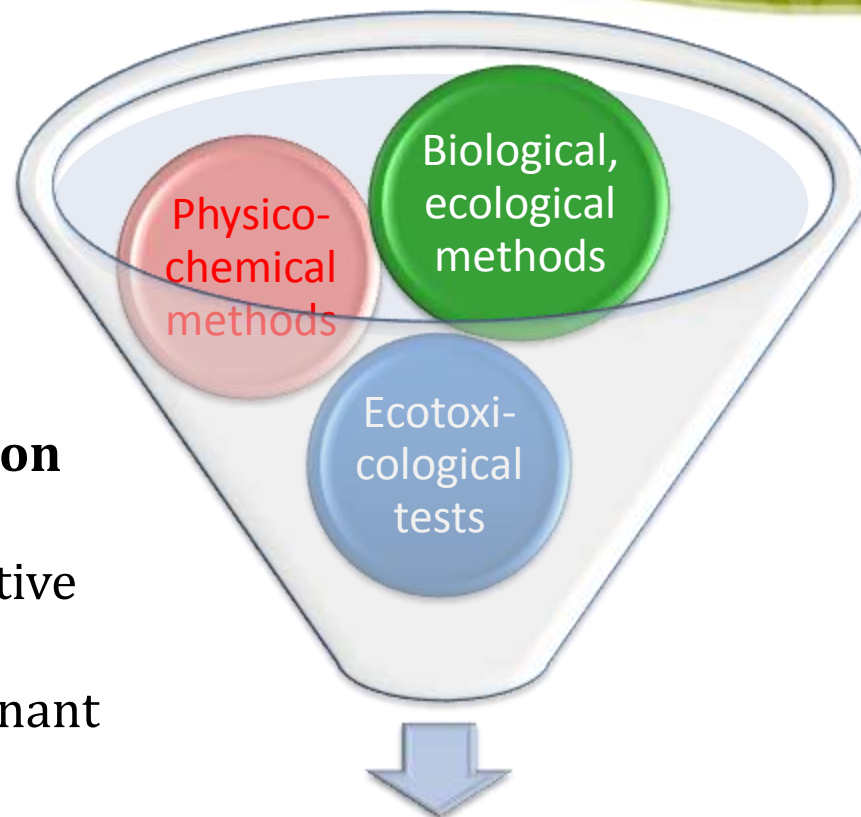


INTEGRATED MONITORING for SOIL



Integrated monitoring gives information

- on the characteristics of the soil: the biological status, the activity and adaptive behaviour of the biota
- on the quality and quantity of contaminant (or waste)
- about the effects, mobility, bioavailability, biodegradability of the contaminants (or waste)...



**INTEGRATED MONITORING-
SOIL TESTING TRIAD**

PHYSICO-CHEMICAL METHODS STT

Physico-chemical methods

- Physico-chemical characteristics of soil (three phases)
- *pH, temperature, redox potential, water holding capacity, nutrient supply...*
- Contaminant analyses (quality, quantity)
- Physical and chemical form of the contaminants
- Mobility of contaminants
- ...



BIOLOGICAL AND ECOLOGICAL METHODS STT

Biological, ecological methods

- Information on the physiological state, flexibility and the activity of the soil microflora
- Response of soil's ecosystem on the adverse effects
- *Concentrations of aerob heterotrophic bacteria, fungal species, anaerobic or facultative anaerobic colony forming cells...*
- *Microbial substrate utilization*
- *Diversity of microflora*
- *Respiration, dehydrogenase activity, nitrification, ammonification...*



Ecotoxicity testing

- Integrates interactions between toxicants, between toxicant and matrix
- Measures bioavailable ratio of the contamination
- Measures chemically not measurable toxicants by their effect
- Measures the effects of chemicals not included into the analytical programme

Testorganisms from different trophic levels



SOIL MICROCOSMS

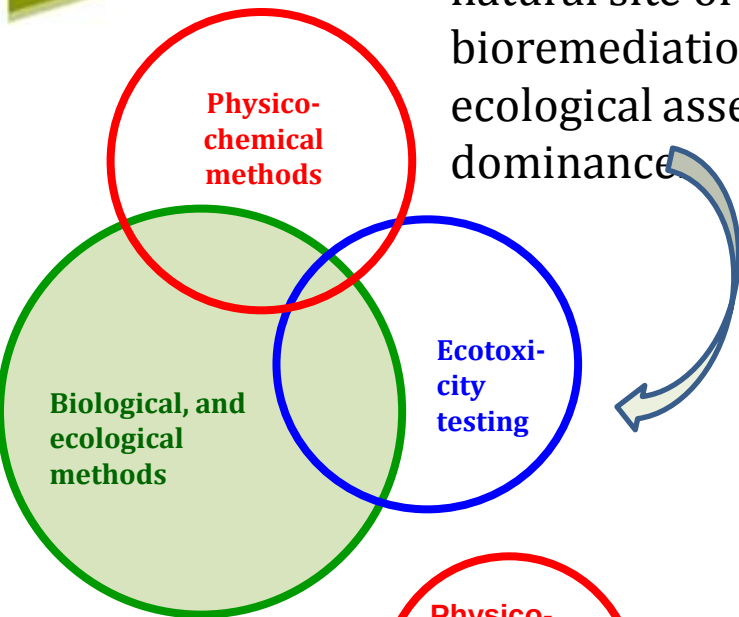
Microcosms → multispecies systems → complex procedures and interactions

- To predict transport and fate of contaminants under controlled conditions
- Modelling *ex situ* and *in situ* soil remediation
- Investigation the effect of technological parameter
- Planning remediation/ bioremediation
- Monitoring remediation
- Monitoring waste utilization on soil
- ...

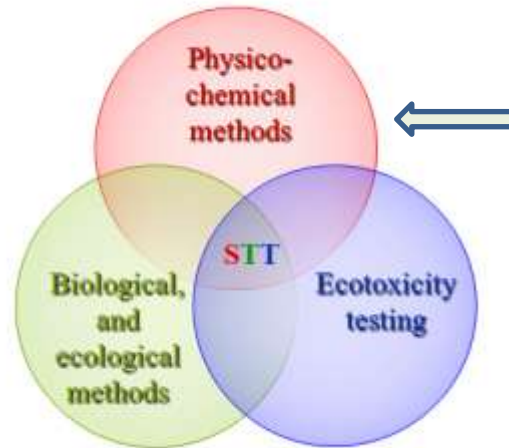


ROLE AND DOMINANCE OF TRIAD ELEMENTS

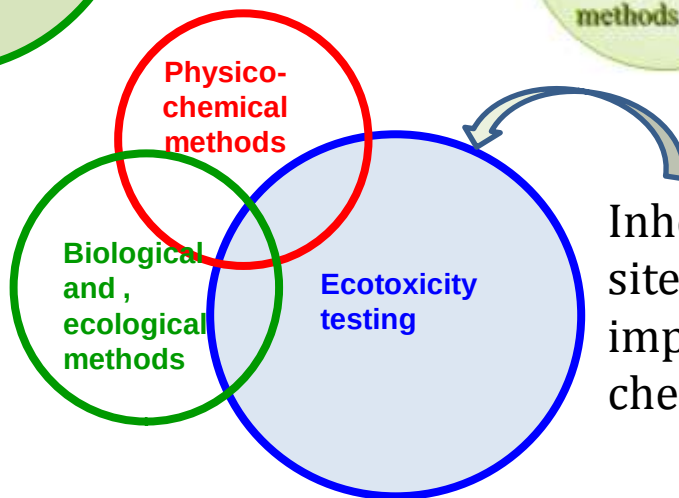
Assessment of a contaminated natural site or planning bioremediation → the biological, ecological assessment may have dominance



Detailed site assessment and planning an *in situ* remediation → the three elements of the Triad have equal importance.



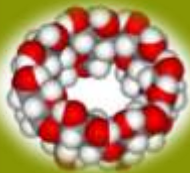
Inherited, long-term contaminated industrial sites → ecotoxicity testing has dominate importance → presence of not identified chemicals, mixtures of chemicals



SOIL REMEDIATION AND INTEGRATED TECHNOLOGY MONITORING

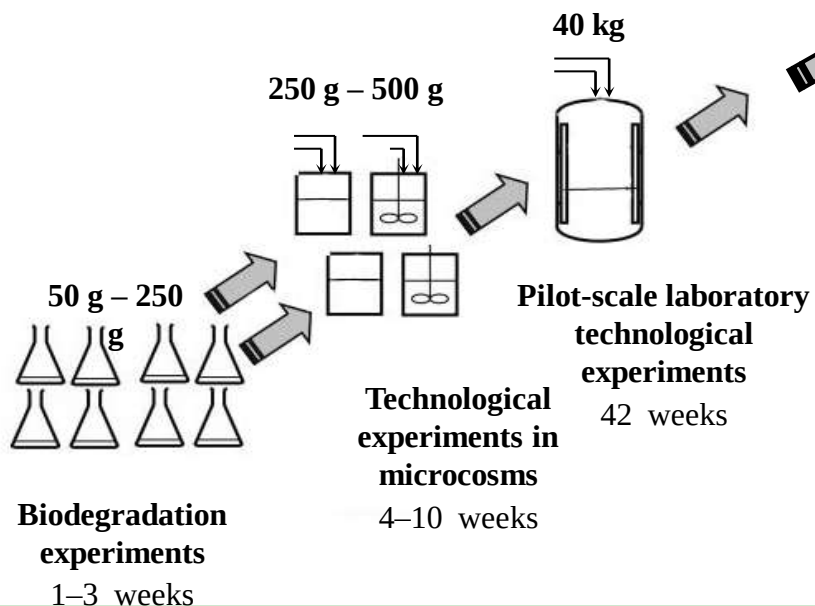
Cyclodextrin enhanced bioremediation





MONITORING OF SOIL BIOREMEDIATION – technology development for transformer oil contaminated site

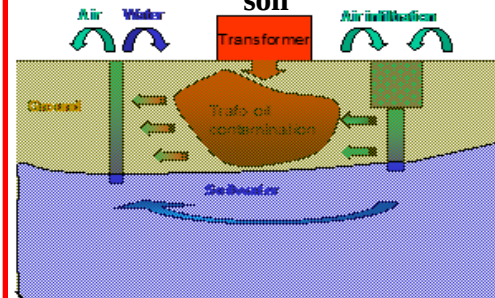
Development of the technology



Application of CDT

30 m³, 50 t of contaminated

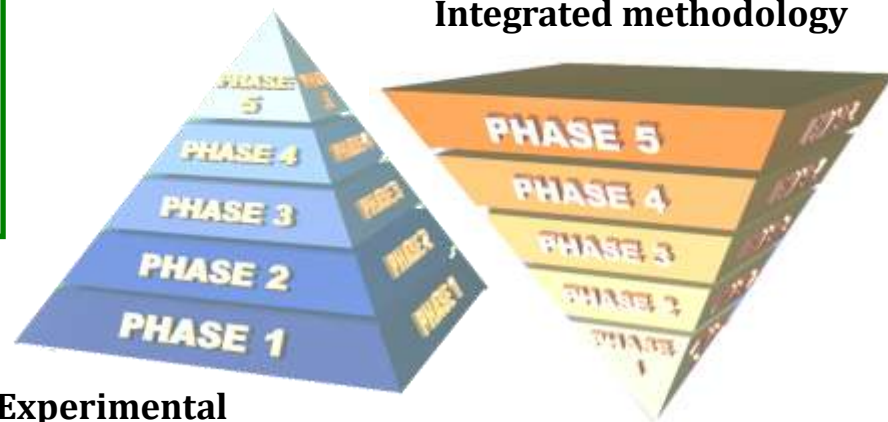
soil



Field application

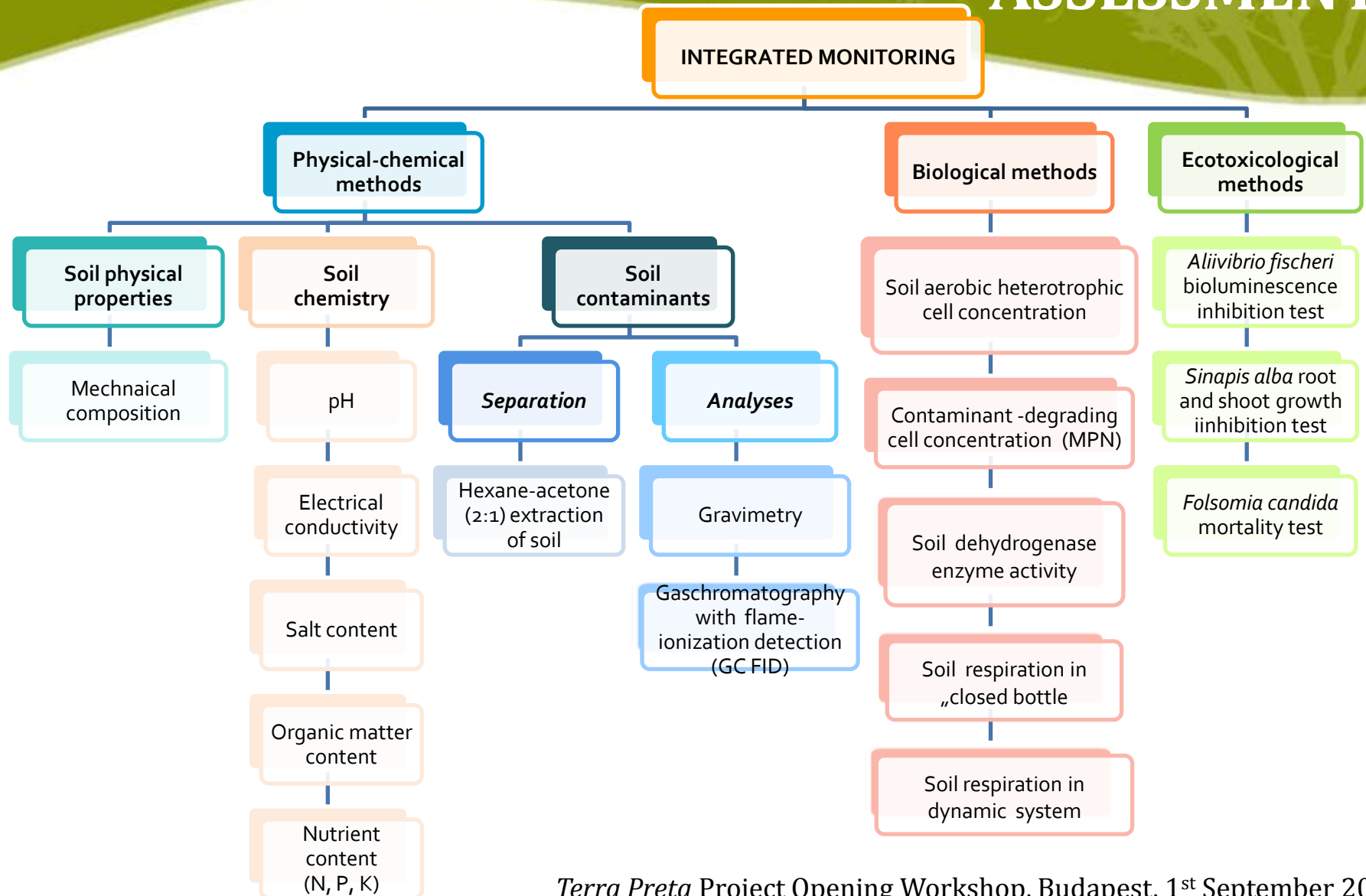
In situ CycloDextrin Technology –
47 weeks

Integrated methodology

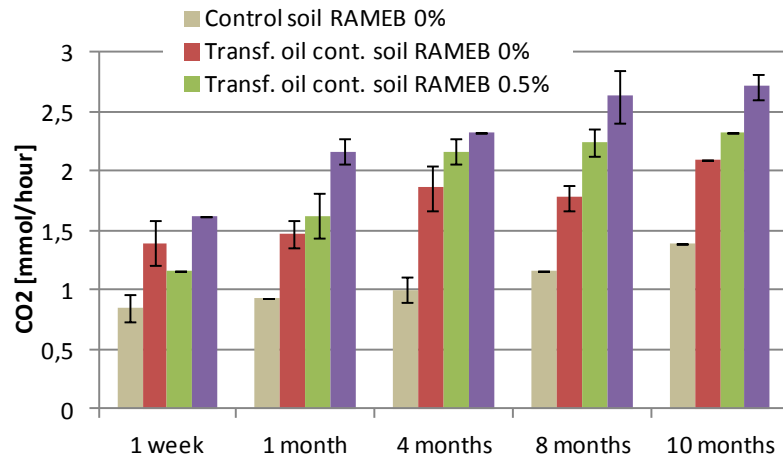


Experimental

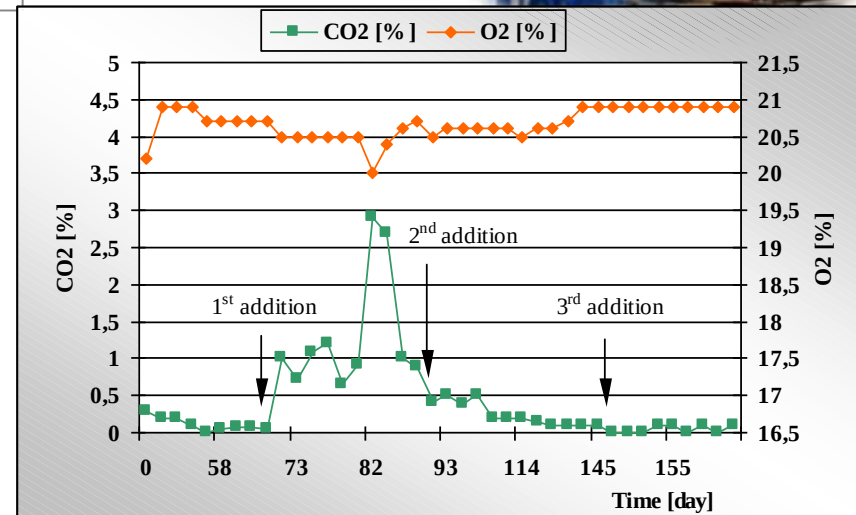
PLANNING BIOREMEDIATION - DETAILED SITE ASSESSMENT



RESULTS OF TECHNOLOGY MONITORING



Soil sampling		EPH-content in the soil [mg/kg]		
Depth [m]	Start	24. weeks	47. weeks (end)	
0.1 m – 0.3 m	20,000-30,000	1 600	210	
0.8 m – 0.9 m	20,000-30,000	800	260	



SOIL IMPROVEMENT by WASTE UTILIZATION

INTEGRATED TECHNOLOGY MONITORING



SOIL IMPROVEMENT – *UTILIZATION OF RED MUD-SOIL MIXTURE*

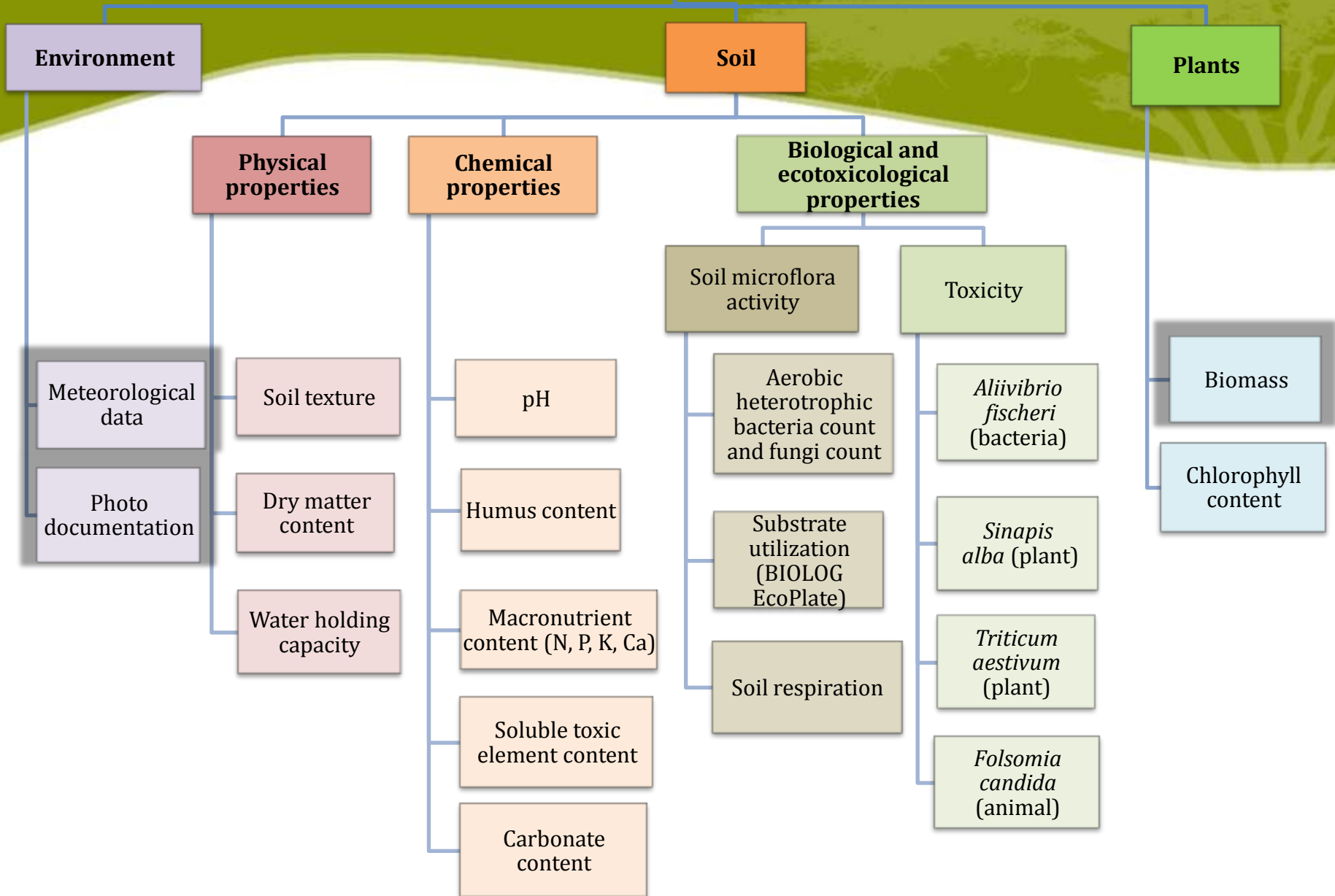


- Red mud catastrophe in Ajka, Hungary
- After the disaster the thick (>5 cm) red mud layer from soil surfaces was removed

- Field demonstration for the utilization of red mud-soil mixture to cover landfills
- To study the beneficial effect of the red mud-soil mixture (red mud contaminated soil) when applied in soil substitute

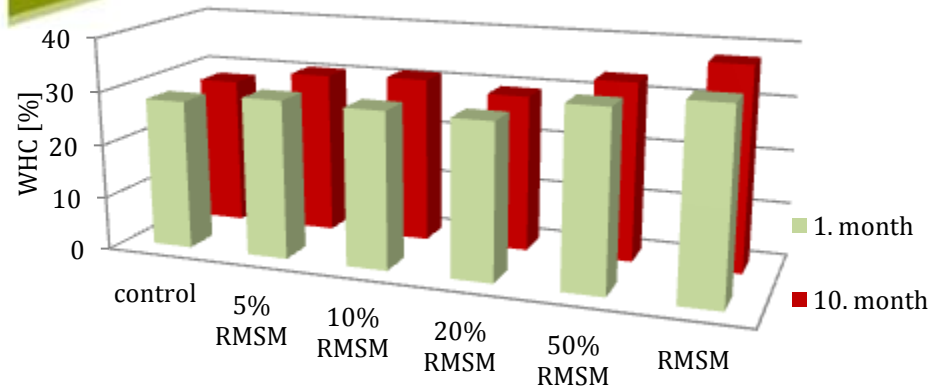


Integrated monitoring
Soil improvement by utilization of red mud-soil mixture



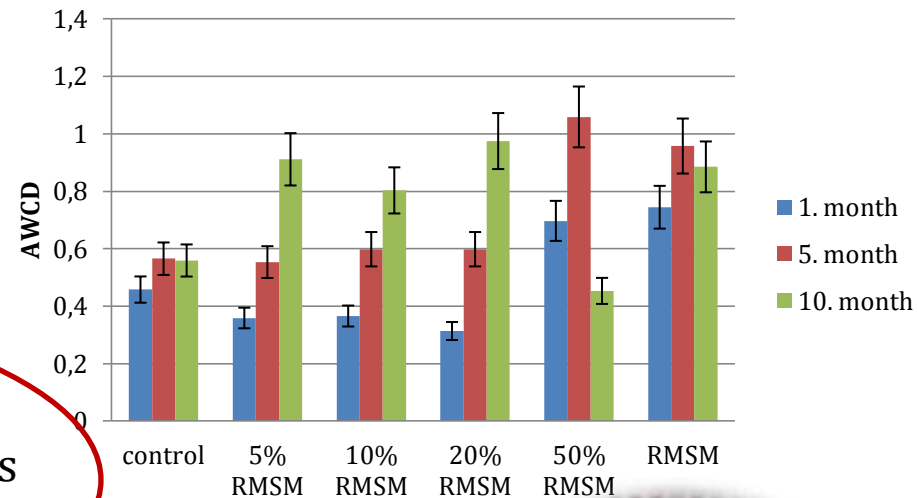
UTILIZATION OF RED MUD-SOIL MIXTURE - RESULTS

Water holding capacity change



Red mud contaminated soil used for soil improvement up to 20% has positive effects on the subsoil and no harmful effect on the environment.

Average Well Color Development Values 120 h



Aliivibrio fischeri (bacteria)

No toxic effect

Sinapis alba (plant)

No toxic effect

Folsomia candida (animal)

No toxic effect



Thank you for your attention!

The experiments were carried out in the framework of the *NATO Science for Piece* (SfP 973720) and the *SOILUTIL* (TECH_09-A4-2009-0129) Hungarian R&D projects

