Artificial soils for urban greening and urban farming

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Necessity of creation of artificial soils

- Light
- Water
- Heat
- Air
- Biota
- Nutrients and organic matter
- Soil

Air
Heat
Light
Water

and organic
matter

Soil

Necessity
of creation
of artificial
soils
Amount of precipitation in arid zone:
< 150-200 mm a year
(< 1 liter a day)
http://koeppen-geiger.vu-wien.ac.at/

Date Palm (Phoenix dactylifera) requirements in water: 7-11 liters a day
https://www.csbe.org/date-palm-phoenix-dactylifera
A large amount of water can be lost during irrigation of native soils due to preferential water flow. As a result upper layer of soil is not moistened, and water migrated to lower layers.
Example of possible substrates and materials for sustainable soil construction in drylands

SOIL SUBSTRATES
- Preventing peat degradation
- Saving high water retention and available water content
- Lowering thermal conductivity
- Preventing evaporation losses
- Leveling of daily thermal shifts

PEAT
- Preventing drainage losses
- Preventing salinization during irrigation

SAND

NATURE AND SYNTHETIC POLYMERS
- Increasing water retention ability
The studies of soil constructioning

**Hidro-thermal insulation layer**

```
<table>
<thead>
<tr>
<th></th>
<th>A arable</th>
<th>Peat</th>
<th>Sand</th>
<th>Mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>18 cm</td>
<td>12 cm</td>
<td></td>
<td>WRB: Urbic Anthrosol</td>
</tr>
</tbody>
</table>
```

* WRB: Urbic Anthrosol
Biomass growth on different artificial soils

- Mean line
- Median
- 25%-75%
- Min-Max

- Native soils
- Layered constructions
- Mixed constructions

Mixed constructions

Native

Layered

Mixed
Cellulolytic fungi in different soils

Native soil
Urban soil
Artificial soil

% 100
90
80
70
60
50
40
30
20
10
0
Laboratory test of substrates → Computer simulation → Field experiment → Computer modelling to prognose the artificial soils behavior in different conditions → Technology
Laboratory test of substrates → Computer simulation → Field experiment

Stages of the process

Computer modelling to prognose the artificial soils behavior in different conditions

Technology
Stages of the process

- Laboratory test of substrates
- Computer simulation
- Field experiment

Computer modelling to prognose the artificial soils behavior in different conditions

Technology
Laboratory test of substrates $\rightarrow$ Computer simulation $\rightarrow$ Field experiment

### Stages of the process

#### Precipitation dynamics (mm) and volume moisture content distribution (%) in soil constructions

<table>
<thead>
<tr>
<th>Days</th>
<th>2012</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Var. 1</td>
<td><img src="graph1.png" alt="Graph" /></td>
<td><img src="graph2.png" alt="Graph" /></td>
</tr>
<tr>
<td>Var. 2</td>
<td><img src="graph3.png" alt="Graph" /></td>
<td><img src="graph4.png" alt="Graph" /></td>
</tr>
<tr>
<td>Var. 3</td>
<td><img src="graph5.png" alt="Graph" /></td>
<td><img src="graph6.png" alt="Graph" /></td>
</tr>
</tbody>
</table>

Data

- Days
- Var. 1
- Var. 2
- Var. 3

#### Computer modelling to prognose the artificial soils behavior in different conditions

- Precipitation
- Moisture content

- Technology
Laboratory test of substrates → Computer simulation → Field experiment → Computer modelling to prognose the artificial soils behavior in different conditions

Technology
The main factors of artificial soils’ development and usage

**Initial data for design**
- Understanding the purposes of using artificial soils (urban farming, urban greening etc.).
- Researching and estimating the environmental parameters and soil substrates characteristics to design artificial soils with precise properties.

**Complex approach**
- The complex of modern investigation methods from different fields of study such as agrophysics, microbiology, agrochemistry, climatology, computer simulation and modeling, etc. is used to design, control and correct the artificial soils’ optimal behavior is necessary to use.

**Possible risks in drylands**
- Salinization as a result of irrigation
- Biological pollution
- Degradation of different artificial soil’s properties
Publications:


Thank you for attention!