

# GREEN ROOFS AS A BIOTECHNOLOGICAL SOLUTION TO INCREASE WATER RETENTION IN URBAN AREAS

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## Introduction

Green Roofs (GR), a multilayer technological construction that uses vegetation on top of buildings or structural slabs, are becoming a strong choice to promote urban greenery, using an area that accounts for ca. 50% of the impermeable urban surface area. Ecosystem services provided by GR include water retention/runoff delay to the stormwater drainage systems, removal of air pollutants and oxygen production, attraction of biodiversity to the urban area, mitigation of the urban heat island effect, energy savings in the buildings, etc. Conservation and enhancement of green infrastructures in urban areas is imperative for sustainable urban development. Aromatic plants have previously demonstrated that could be successfully used on GR in the Mediterranean region. In the present study, an extensive GR pilot system using aromatic plants and a commercial substrate has been studied regarding its capacity of water retention. Inoculation of a selected mixture of plant growth promoting bacteria (PGPB) was carried out to assess the potential of bacterial endophytes in green roofs vegetation.



## Methods

### Green Roof rainwater retention capacity/water runoff

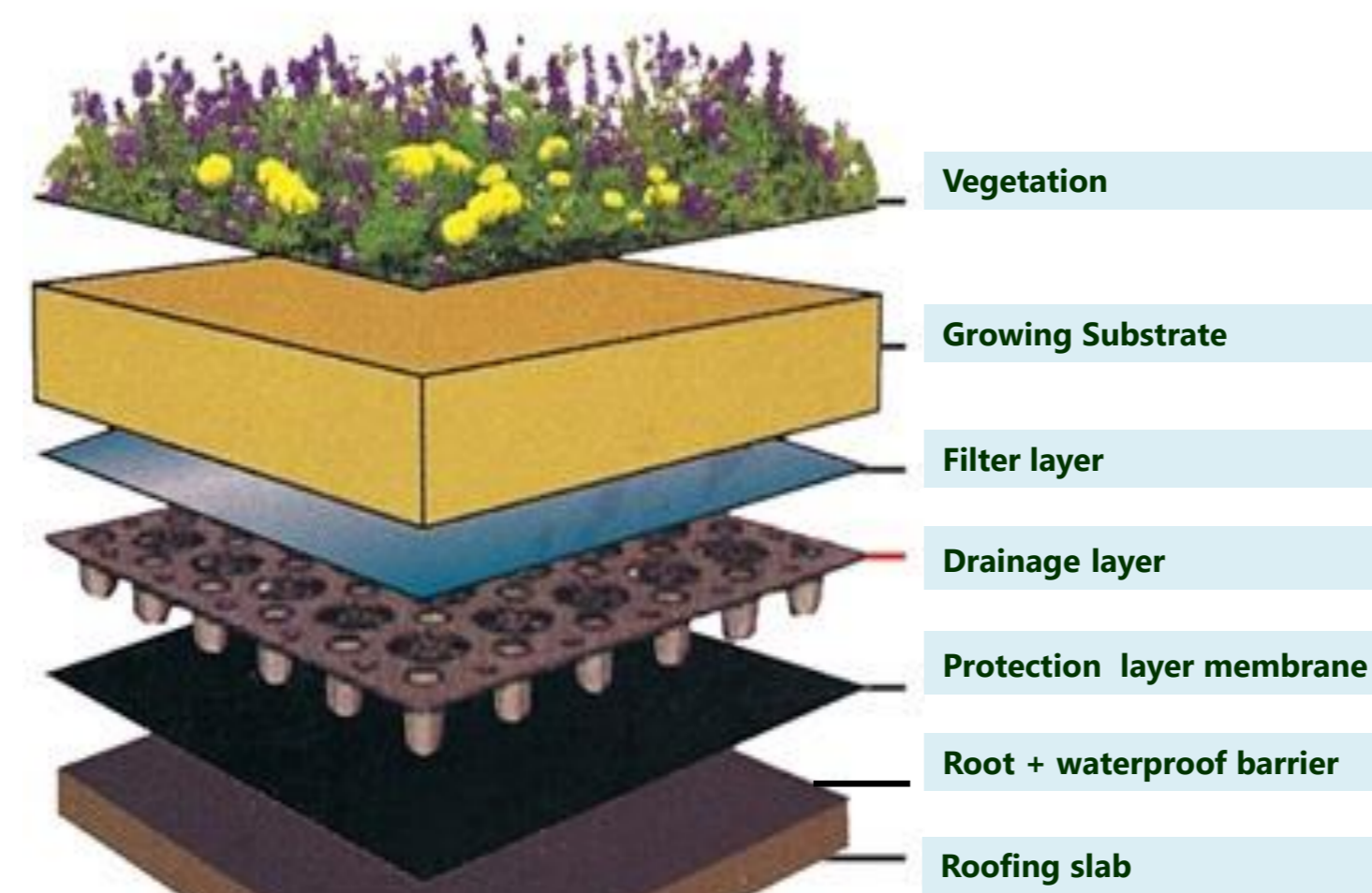
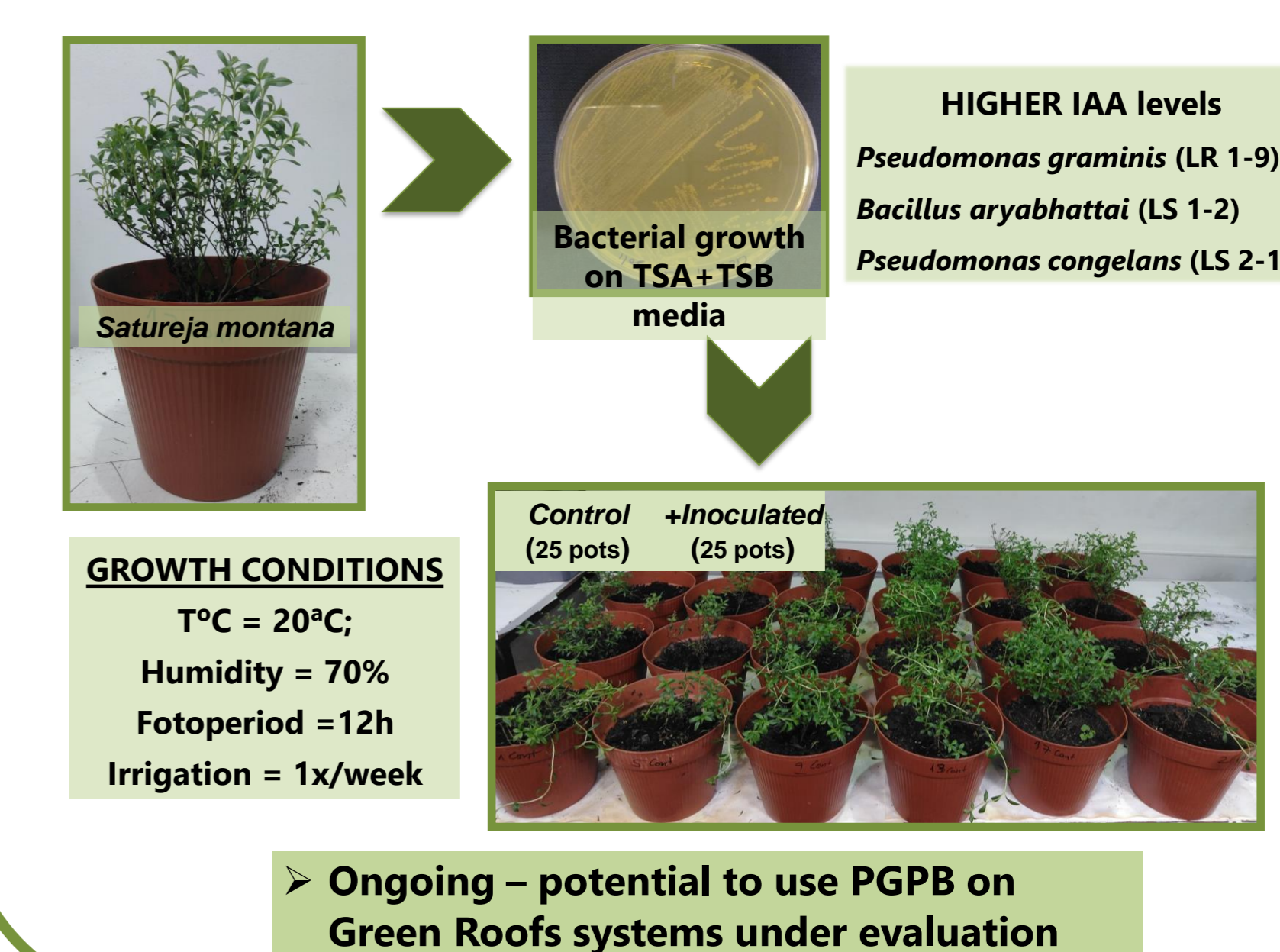


Figure 1: Green roof scheme  
[http://www.greengrassgrid.com/green-roof-drainage-layer-material\\_p32.html](http://www.greengrassgrid.com/green-roof-drainage-layer-material_p32.html)

### Pot experiments - *Satureja montana* growth Control vs. Inoculated with a mixture of PGPB



## Results and Discussion

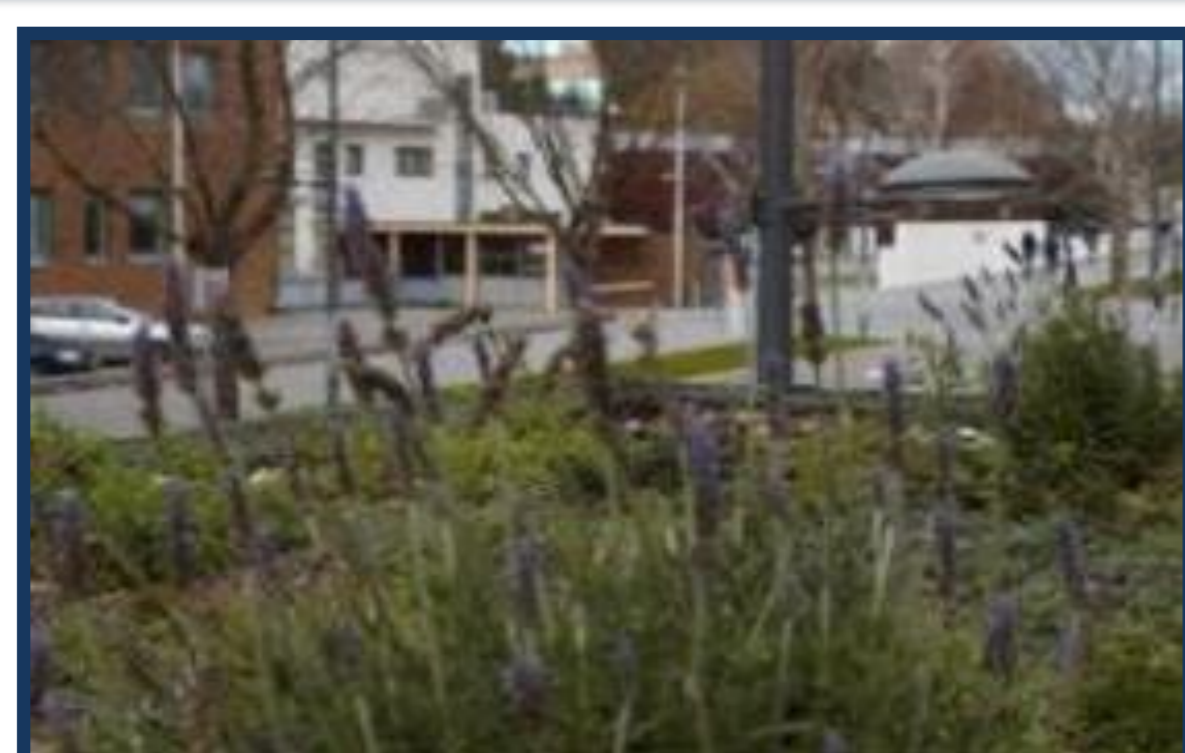
### Green Roof rainwater retention capacity/water runoff

#### FORMULA DEVELOPMENT - MEDITERRANEAN AREA

##### Runoff coefficient

$$C_M = [0.016 (P_M + R_M)] / (2 T_M - T_{M-1})^{1.2}$$

$C_M$  = Runoff coefficient of the month M;  
 $P_M$  = Precipitation of the month M (mm)  
 $R_M$  = Irrigation of the month M (mm)  
 $T_M$  = Mean air temperature of the month M (°C)  
 $T_{M-1}$  = Mean air temperature of the month M<sup>-1</sup> (°C)

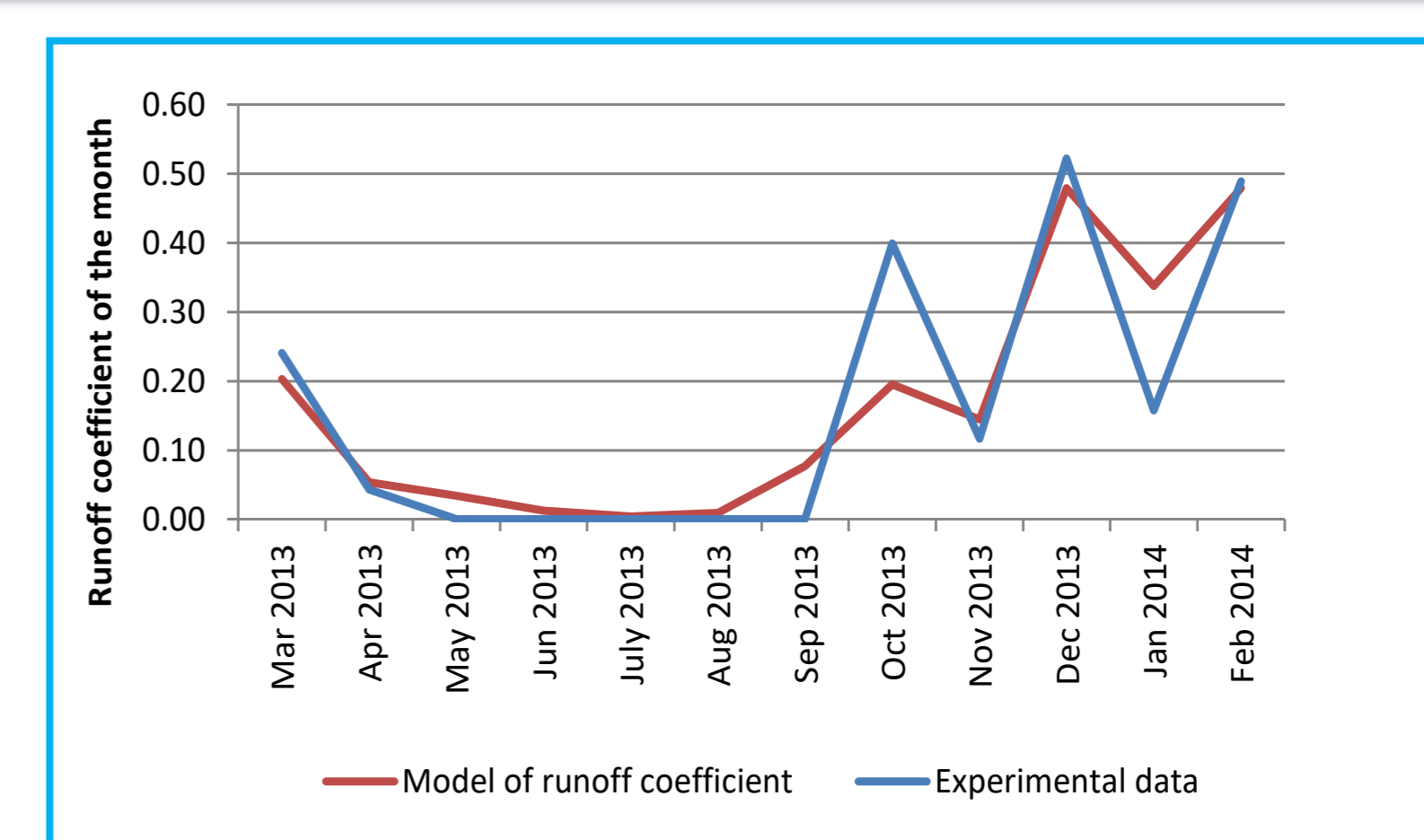


✓ Water runoff: up to 25L/m<sup>2</sup>  
✓ Amount of water retained in substrate: 30%

### Usable water amount

$$V_a = C.P.A.\eta_f$$

$V_a$  = Annual usable rainwater volume (L)  
 $C$  = Runoff coefficient (annual)  
 $P$  = Precipitation in the considered period (mm)  
 $A$  = Captation area (m<sup>2</sup>)  
 $\eta_f$  = Filtration hydraulic efficiency



Runoff coefficient model and experimental data

## Conclusions

- ✓ Determination of runoff coefficient and usable water amount that runoffs GR adds knowledge to the design of rainwater harvesting systems coupled with GR, specially in urban areas with Mediterranean climate characteristics.
- ✓ Based on a previous water runoff model, rainwater retention by the system has been calculated to be ca. 30%.
- ✓ Aromatic species tested proved to be resistant to harsh conditions of rooftops being suitable for GR systems in a Mediterranean climate.
- ✓ Potential of PGPB in helping plant establishment in Green Roofs under evaluation.

### Acknowledgements

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