MESSAGGERI DELLA CONOSCENZA

Soil Bioengineering in peri-urban Mediterranean areas, an international educational project developed by University of Palermo, University of Lisbon, APENA and AIPIN Sicily.

Giuseppe Guerrera[1,2], Carlo Bifulco[3,4,5], Gianluigi Pirrera[6], Roberta Calvo[7], Giuseppe Conti[7], Filippo Rizzo[7], Alessandro Tagliabue[7] and Giulia Trombino[7]

(1) Scientific project head. Email: guer601@gmail.com
(2) Professor of the Polytechnic School, University of Palermo, Palermo, Italy.
(3) Project Coordinator. Email: carlobifulco@isa.ulisboa.pt
(4) Centro de Ecologia Aplicada Prof. Baeta Neves, Instituto Superior de Agronomia, Universidade de Lisboa, Lisboa, Portugal.
(5) APENA President , Lisboa, Portugal
(6) AIPIN,National Vice President , Palermo, Italy. Email: jl.mine@libero.it
(7) Messaggeri della conoscenza program, 181 project, Universita di Palermo, Dipartimento di Architettura, viale delle Scienze ed. 8 - 90128 -, Palermo, Italy. Email: roberta.calvo@yahoo.it, giuseppeconti1988@gmail.com, filyr14@gmail.com, tagale6@hotmail.it, giu-tromby@hotmail.it

Soil Bioengineering applied to landscape architecture in urban and periurban areas characterized by mediterranean climate is a project funded by Italian MIUR within the program Messaggeri della Conoscenza. It aims to promote experimental initiatives in teaching and research in academic centers of excellence.

The project is divided into 3 phases:

• didactic activity at the University of Palermo,
• internship at the Instituto Superior de Agronomia of the University of Lisbon,
• dissemination activities of take home messages learned during the exchange period.

During the first phase, more than 20 participants made three project proposals to achieve a practice construction exercises. The best five participants continued the training program at the University of Lisbon, where they attended the Applied Landscape Ecology and Urban Vegetation courses. They also performed researches on the design and implementation of interventions and experience of Soil Bioengineering.

Coming back to Palermo the activities planned are the dissemination of methods and contents acquired, through the organization of exhibitions, seminars and publications.

Comparison of Portuguese professional reality and academic teaching has allowed new points of view and approaches to a more sustainable land management.

Soil Bioengineering techniques represent a viable alternative to achieve engineering projects with low environmental impact. At the same time they promote biodiversity in areas with a high rate of urbanization.

Involving different academic discipline (botany, landscaping, architecture and engineering), has provided an opportunity for each participant to make available his knowledge to the working team, encouraging both professional and personal growth.

Activities in Palermo. The training activity has provided five days of lectures on the basic principles of the Soil Bioengineering techniques at the University of Palermo.

The 20 selected students, afterwards were divided into three working groups with the aim to develop a slope restoration project.

The projects were evaluated and were used as guidelines for the construction practice exercises provided by the program.


Fig.1 lectures


Fig.2 worksite Group


Fig.3 worksite Group

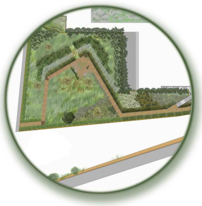
Fig.4 extract from the draft 1


Fig.5 extract from the draft 2


Fig.6 extract from the draft 3

Five students were selected to continue their education at the Higher Institute of Agronomy of the University of Lisbon.
The multidisciplinary group is formed by:

•Roberta Calvo, graduated in Environmental Sciences and specialized in Environmental Redevelopment and Soil Bioengineering;

•Giuseppe Conti, architecture graduate candidate;

•Filippo Rizzo, graduate in Natural Sciences and student of Biology and Ecology;

•Alessandro Tagliabue, architecture graduate candidate;

•Giulia Trombino, graduated in architecture.

The activities In Portugal included:
•Two workshops; one in Quinta do Pisão, Cascais, about the creation of three hedge brush layers, and one in Ourem where the Soil Bioengineering works made within the river have been inspected.
•Participation to the CEABN collaboration with the entity that manages the Portuguese national roads and highways for the construction of engineering works on the natural slope of a motorway junction.
•The development of plans for the consolidation of landslides on the island of San Miquel in the Azores, through the use of Soil Bioengineering techniques.
•Rooting test by cuttings of Ruta chalepensis to check the rooting percentage in a different period from the usual one.
•Experimental tests on the propagation by cuttings of Ruta chalepensis used as a pioneer species in the recovery of quarries.
•Collaboration in botanical and forestry research on the rooting of four plant species in different parts of Portugal.


Fig.7a Malveira highway construction, initial stage


Fig.7b Malveira highway construction, final stage


Fig.7c detail of the intervention in Malveira


Fig.10 Ruta's Flower


Fig.11 workshop Quinta do Pisao


Fig.12 workshop Ourem


Fig.10 plants extraction Group


Fig.11 root systems measurement


Fig.12 project extract from the Azoorre work

The tables (1 and 2) show the morphometric analysis of 18 species conducted during the construction site set up stage. The botanical project involved:

•The removal of invasive alien species existing such as Alianto, Castor, Fountain Grass and Aptenia

•The introduction of native species suitable for the Soil Bioengineering works: Carob, Hawthorn, Fig, broom, Juniper, Laurel, Myrtle, Olive, wild pear, Rosehip, Rosemary

•The extraction of the other species tolerated. in the location.

These species do not cause ecological disturbance and indeed are useful for biotechnical purposes: Lantana, Inula and paper mulberry.
On each sample, the measurements were made on root systems and aerial root (Figure 13)
The procedure has led to the expected results also highlighting the importance of this kind of analysis with the aim to obtain a better knowledge on the roots morphology for the evaluation of a slope stability in the long term. Morphometric research has continued in Lisbon with different methods and instrument on Ruta plants (Figure 14).

Specie autoctone	P (cm)	Aip (cm)	L (cm)	H (cm)	Aep (cm)
Ceratonia siliqua L.	30	13	17	82	35,6
Crataegus monogyna Jacq.	48	11	19	86	34
Ficus carica L.	34,5	13,5	30	34	27
Genista aetnensis (Raf.) DC	36	13	22	172,5	14
Juniperus macrocarpa	26,5	8,5	22	76,5	8
Laurus nobilis L.	33,5	15	23	20	15
Myrtus communis L.	33	10	27	20	13
Olea europaea L. var. sylvestris Brot.	42	10	20,5	50	14,5
Pyrus pyraster (L.) Duroi	21	10	21	55	24
Rosa canina L.	23	12	16,4	47	11
Rosmarinus officinalis L.	28,5	13	22	48	10

Specie alloctone	P (cm)	Aip (cm)	L (cm)	H (cm)	Aep (cm)
Ailanthus altissima (Mill.) Swingle	>110	48-20	40	55	40-60
Aptenia cordifolia (L.fil.) N.E. Br.	32	N.C.	32	14	98
Pennisetum setaceum (Forssk.) Chiov.	24	23	22	76	90
Pennisetum setaceum (Forssk.) Chiov. (individuo singolo)	25	19	20	71	60
Ricinus communis L.	15,7	11	14,5	33	23,5

Specie tollerate	P (cm)	Aip (cm)	L (cm)	H (cm)	Aep (cm)
Broussonetia papyrifera (L.) Vent	58	55-37	37	70	50-35
Inula Viscosa (L.) Greuter	35	26	35	42	23
Lantana camara L.	32,5	60-44	32,5	67	80-60

A = radical hemispherical index
S = relative stability index
Sp = potential stability index
s = relative strength Index
R= radical stability Index
P= global stability Index

Specie alloctone	P (cm)	Aip (cm)	L (cm)	H (cm)	Aep (cm)	P (cm)
Ailanthus altissima (Mill.) Swingle	>1,6	>2	0,727	0,68	>1,36	>0,924
Aptenia cordifolia (L.fil.) N.E. Br.	N.C.	2,28	2,28	N.C.	N.C.	N.C.
Pennisetum setaceum (Forssk.) Chiov.	0,52	0,315	0,289	0,256	1,23	0,02
Pennisetum setaceum (Forssk.) Chiov. (individuo singolo)	0,658	0,35	0,28	0,317	1,104	0,035

Specie autoctone	P (cm)	Aip (cm)	L (cm)	H (cm)	Aep (cm)	P (cm)
Ceratonia siliqua L.	1,15	0,36	0,2	0,365	0,986	0,057
Crataegus monogyna Jacq.	2,18	0,558	0,22	0,323	1,727	0,058
Ficus carica L.	1,28	1,014	0,88	0,5	2,028	0,5
Genista aetnensis (Raf.) DC	1,38	0,208	0,127	0,928	0,224	0,179
Juniperus macrocarpa	1,56	0,346	0,28	1,06	0,326	0,388
Laurus nobilis L.	1,116	1,675	1,15	1	1,675	1,675
Myrtus communis L.	1,65	1,65	1,35	0,77	2,14	0,978
Olea europaea L. var. sylvestris Brot.	2,1	0,84	0,41	0,2	4,2	0,0336
Pyrus pyraster (L.) Duroi	1.05	0,38	0,38	0,4166	0,912	0,0659
Rosa canina L.	0,958	0,48	0,348	1,09	0,44	0,57
Rosmarinus officinalis L.	1,09	0,59	0,458	1,3	0,453	0,997
Ricinus communis L.	1,42	0,475	0,439	0,468	0,2223	0,104

Specie tollerate	P (cm)	Aip (cm)	L (cm)	H (cm)	Aep (cm)	P (cm)
Broussonetia papyrifera (L.) Vent	0,63	0,828	0,528	1,08	0,894	0,965
Inula Viscosa (L.) Greuter	0,673	0,84	0,84	1,13	0,949	1,079
Lantana camara L.	0,325	0,48	0,48	0,742	0,646	0,264

P = rooting depth
Aip = rooting breadth
L= main lenght
H = epigeal height
Aep = epigeal breadth


Fig.13 root systems Measurement

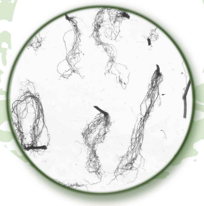
Fig.14 winrhizo software scan images

Bibliografia: https://messaggeri.cineca.it/, http://apena.pt/f/public/Proceedings_Congresso_2012.pdf, http://www.cm-ourem.pt/index.php/agenda/details/1265-seminario-engenharia-natural-uma-solucao-ecologica-tecnicas-e-aplicacoes-praticas.html

Cornelini P., Federico C., Pirrera G., 2008 - ARBUSTI AUTOCTONI MEDITERRANEI PER L'INGEGNERIA NATURALISTICA : Primo contributo alla morfometria degli apparati radicali. Azienda Regionale Foreste Demaniali.

Graphic design: Giuseppe Conti
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Texts: Roberta Calvo and Giulia Trombino
Graphs and charts: Filippo Rizzo