RESTORE DESERTIFIED AREAS WITH AN INNOVATIVE TREE GROWING METHOD TO INCREASE RESILENCE: THE GREEN LINK PROJECT IN VALENCIAN COMMUNITY (SPAIN)

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INTRODUCTION

Nowadays, the current understanding of European climate trends leads to an expected overall temperature increase from 2º to 4ºC and precipitation changes of 10 to 50% by the 2080s (IPCC, 2014). The changes are not equally distributed across different regions or seasons and these changes are likely to become more pronounced in southern Europe with temperature increase reaching +5ºC and particularly, an increase of drought periods throughout the Mediterranean region (Iglesias and Garrote, 2015). Currently, many semi-arid Mediterranean areas are suffering significant decline in water availability and temperature increases, being necessary to implement adaptation measures aimed at reducing the vulnerability of these ecosystems and strengthening their resilience. In this region, where soil degradation is one of the most threatening consequence of clime change (Rubio and Recatalá, 2006), the successes of afforestation and reforestation actions are frequently related to the annual rainfall, soil type and seedling quality (Tsakaldimi et al., 2005; Chirino et al., 2008). Between abiotic factors, soil type and water availability are often the critical points in the plantation establishment phase. Planting seedlings in drylands and degraded soils is often discouraging because of high mortality rates and poor growth (Cortina et al., 2004). Even if plantation takes place with regular irrigation, the survival rate is at most 50%, but in many cases even lower as over-irrigated root-systems do not penetrate deep soil.

Related to the adaptation to risk of desertification and to risk of biodiversity loss, the Green Link Project (LIFE15 CCA/ES/000125) aims to mitigate impacts of climate change and contribute to increase resilience of Mediterranean ecosystems, specifically in Spain, Greece and Italy. Their general objective is to demonstrate the environmental and economic benefits of an innovative tree growing method in desertified areas based on a new ‘water bucket’ system: The ‘Cocoon’. Under this overall aim, here we present the two trial areas in the Valencian Community (Jijona and Tous) where Cocoons has been already installed with the objective to compare their suitability under contrasted edaphic and climatic conditions.

METHODS

Cocoon device

The Cocoon consists of a water reservoir, mycorrhizal fungi, and a tree shelter (Figure 1). It is made of recycled paper pulp and grass fibres sealed with a natural wax to ensure water tightness during the first year in the field. The Cocoon is put into a soil hole (approximately 60 cm wide and 30 cm deep). In the middle of the hole, a seedling is planted first, and then the Cocoon is put around it (Figure 2). Moreover, mycorrhizal fungi are added to the soil surrounding the plant roots. It is only water filled once at the time of planting (with 25 L water) and the wicks allow slow water transport from the Cocoon to the root zone. Later on, it is covered with the lid made from the same material. Finally, a cylindrical shelter is placed around the tree to protect the seedling against the sun, desiccating winds and animal feeding on the young plant. A more detailed description is given in Carabassa et al. (in this Conference).

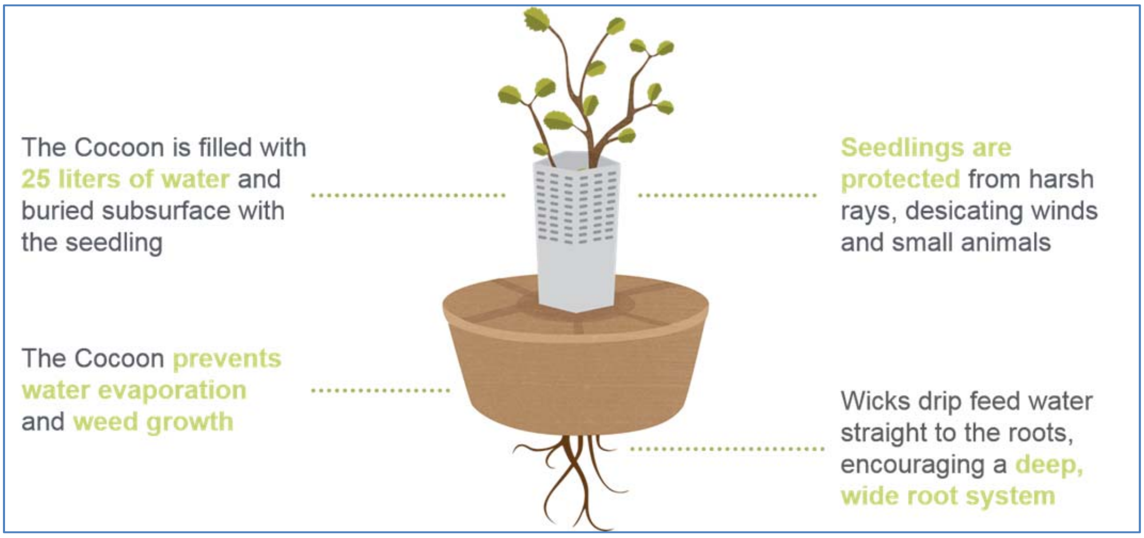

Figure 1. Scheme of the Cocoon device

Figure 2. Some details of plantation process

Description of trial areas

Tous trial area (Figure 3) (latitude 39°13'9.58" N and longitude 0°40'31.97" W) is placed in the municipality of Tous, 60 km SW of Valencia city (Spain) on land ceded by the Government of Comunidad Valenciana. It is located at 446 m a.s.l on a plateau mountain area with a long history of disturbances (fire, clearing, overgrazing ...). In fact, the trial area suffered a wildfire on 2012. Their current land use is a Mediterranean shrubland on a recovery stage with *Quercus coccifera*, *Pistacea lentiscus*, *Rhamnus lycioides*, and *Rosmarinus officinalis* as dominant specie, that cover between 30-60% of the soil surface. The soil is a Chromi Luvisol developed on Cretacic limestone, with a variable depth always less than 50 cm, generalized outcrops, stoniness abundance higher than 50%, with a good drainge and features of karst morphology. Soil present a clayed texture, alkaline pH, and an average organic matter content of 2.98% in the first 30 cm. Climatically the area belongs to the Semiarid cold (BSk) according to Köppen Classification. Mean monthly temperatures range from 10.6 ºC (January) to 25.5 ºC (August). The total annual precipitation is 424 mm/year, with a maximum in October and a dry period from June to September. Data recorded by the meteorological station placed at Tous resevoir recorded only 44 rainy days in 2015. The challenge in Tous is to recover the burned area in 2012 by using adaptive and economic interest tree species (Table 1).

Jijona trial area (Figure 3) (latitude 38°31'47.08"N and longitude 0°27'45.69"W) is located in the municipality of Jijona (Alicante, Spain). It covers 2.04 ha of abandoned almond cropland. The present owner ceded the land to the project to achieve landscape recovery and also to recover it mainly for olive crops. According Köppen Classification, climet type is BSk (Semiarid cold). Mean monthly temperatures range from 8.9 in January to 24.7 in August. The total annual precipitation is 445 mm/year, with a maximum in October and a dry period from June to September. Data recorded by the meteorological station placed at Tibi reservoir recorded only 45 rainy days in 2015. The current land use is abbandoned terraces with some shrubland (*Quercus coccifera*, *Thymus vulgaris* and sparse species of *Rosmarinus officinalis*, *Stipa tenacissima*, and *Globularia alypum*), grasses on perimeter of terraces (*Brachypodium retusum*) and some sparse trees (*Pinus halepensis* and *Ceratonia siliqua*). Soil is developed over Early Cretacic marls and classified as Calcaric Regosol, with alkaline pH, loam texture, low organic matter content (1.77% in the first 30 cm depth) and high carbonate content (> 80%).

In Jijona the challenges are (1) to improve the extremely dry and eroded soils in an abandon almond cropland on Early Cretacic marls by planting adaptive species (Table 1) and (2) to offer an economic alternative for land owners by planting mainly *Olea europea* using Cocoon technology.

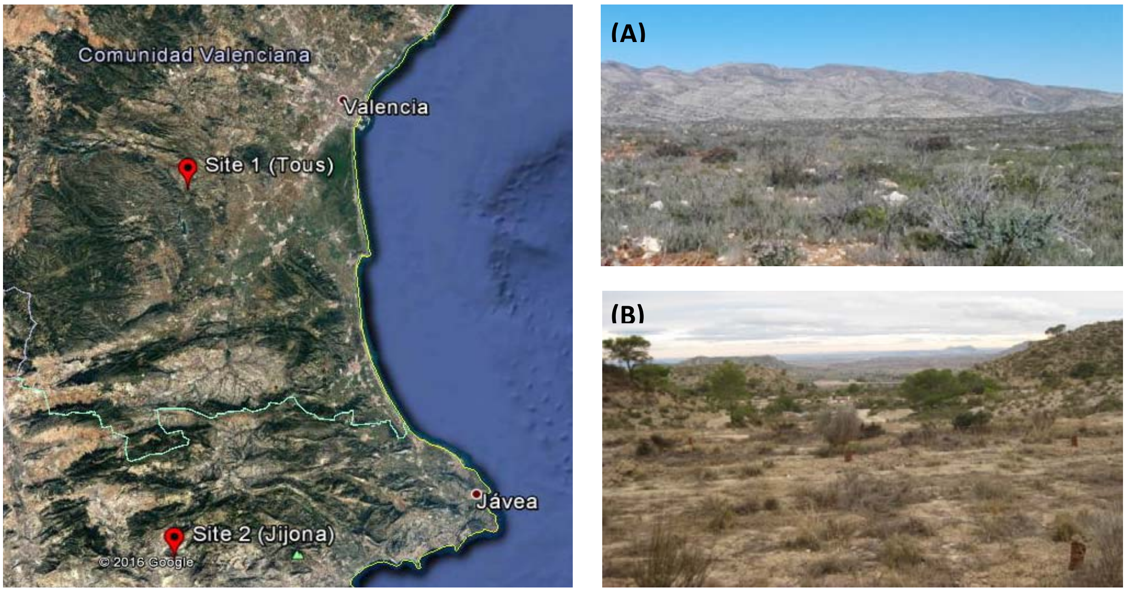

Figure 3. Location of trial areas and general view of each site (A) Tous and (B) Jijona

Table 1. Main species planted in each trial area

	Tous	Jijona
Surface (Ha)	3	2.04
Date	17-29 October 2016	3-7 November 2016
Specie		
Olea europea	160	480
Tetraclinis articulata	140	94
Pinus halepensis	500	75
Quercus ilex	200	27
Ceratonia siliqua	30	30
Arbutus unedo	125	26
Other	20	20
Total	1175	742

EXPECTED RESULTS

The main expected results are in agreement with The Green Link project ones:

1. Demonstrate that the Cocoon technology allows planting trees in dry climates and on poor soils in response to combat desertification phenomena. It is expected to achieve a 90% survival rate after planting, for all the species selected.
2. Offer a competitive market solution to plant trees, without the use of irrigation with the Cocoon, by demonstrating that there will be significant savings of up to 30% for planters (taking into account lower maintenance and dead trees repositioning costs) vs traditional methods in these areas or alternatives.
3. Improve soil quality since water scarcity will be compensated; further green cover, microorganisms and mycorrhiza will enhance the association among roots and soil, planting along height lines will help prevent erosion while improving water retention in the area.
4. Enhance ecosystem services, notably increasing biodiversity, landscape quality and positive growth of soil carbon stock over time.

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