From Forest Nursery Notes, Winter 2012

71. © Differential field response of two Mediterranean tree species to inputs of sewage sludge at the seedling stage. Valdecantos, A., Cortina, J., and Vallejo, V. R. Ecological Engineering 37:1350-1359. 2011.

Ecological Engineering 37 (2011) 1350–1359

Contents lists available at ScienceDirect

Ecological Engineering

journal homepage: www.elsevier.com/locate/ecoleng

Differential field response of two Mediterranean tree species to inputs of sewage sludge at the seedling stage

Alejandro Valdecantos[a,*], Jordi Cortina[b], V. Ramón Vallejo[a]

[a] Centro de Estudios Ambientales del Mediterráneo (CEAM), C/Charles R. Darwin 14, Parque Tecnológico, 46980 Paterna, Spain
[b] Departamento de Ecología, Universidad de Alicante, Ap. 99, 03080 Alicante, Spain

ARTICLE INFO

Article history:
Received 5 November 2010
Received in revised form 8 March 2011
Accepted 27 March 2011
Available online 22 April 2011

Keywords:
Biomass allocation pattern
Biosolids
Foliar isotopic composition
Pinus halepensis
Quercus ilex
Restoration
Vector diagnose

ABSTRACT

Land degradation and desertification is a common feature in Mediterranean landscapes due to extensive and intensive land use and natural or man induced disturbances. The ecosystem may need external inputs to recover its composition and function as soils are often impoverished and vegetal key stone species lost. We evaluated the effects of the application of fresh and air-dried biosolids in the establishment and morphological and physiological performance of seedlings of *Pinus halepensis* and *Quercus ilex* under dry Mediterranean field conditions. Seedling survival was not affected by biosolid treatments in any of the studied species both two and ten years after planting. During the first two years, growth was enhanced by the two biosolid treatments in relation to control, although the change in the biomass allocation pattern differed between species. Rooting depth was significantly enhanced by liquid biosolid in *Q. ilex* and marginally reduced in *P. halepensis* as well as the exploration of soil. As a consequence, root-to-shoot ratio reduced significantly with dry and liquid sludge due to promoted aboveground growth while maintaining and even reducing belowground fractions. An improvement of the nutritional status, of fertilized seedlings especially of phosphorus, is the explanation for the better field performance. Vector analysis revealed an important phosphorus limitation for both species that was overcome with the application of liquid (both species) and air-dried biosolid (pine). The higher growth of pine seedlings attained in the liquid biosolid treatment was coupled with a significant decrease in foliar $\delta^{13}C$, suggesting lower water use efficiency. The significant increase in foliar $\delta^{15}N$ in the biosolid treatments in both species suggested that a large proportion of the total nitrogen uptake came from the applied biosolids. Instead, with regard to the low biosolid application rate used in the study, treatments had an overall positive effect as a restoration tool by improving nutritional status and promoting growth of planted seedlings.

1. Introduction

Mediterranean landscapes have been extensively modified by land use (Grove and Rackham, 2001). Over the last decades, forest plantations and spontaneous colonization of marginal agricultural land may have favored the increase in forest cover (either woodland or shrubland) and fire occurrence (Romero-Calcerrada and Perry, 2004; Vega-García and Chuvieco, 2006). When a disturbance such as a fire event takes place, the recovery of pre-disturbance ecosystem integrity may be too slow for society's needs, and favor further negative landscape processes such as erosion (Pausas et al., 2008). Under these circumstances, restoration actions have been recommended to foster the establishment of keystone woody species, reassemble forest communities and improve ecosystem functioning (Cortina et al., 2006; Vallejo et al., 2006).

Degraded Mediterranean soils are often impoverished in organic matter and nutrients (Martínez-Mena et al., 2002; Alguacil et al., 2009) and the establishment of tree seedlings can be hampered by low availability of soil resources (Grogan et al., 2003; Valdecantos et al., 2006). The application of organic amendments may improve soil fertility and water availability, promote biological activity and facilitate seedling establishment (Henry et al., 1994; García et al., 2000; Querejeta et al., 2001; Larcheveque et al., 2006a). Sewage sludge has been widely used in agriculture and commercial forestry, but its use for the restoration of degraded Mediterranean areas is scarce and mostly restricted to the forestation of abandoned agricultural fields and severely damaged areas such as minesites (Navas et al., 1999; Brofas et al., 2000; Jorba and Andrés, 2000; Ojeda et al., 2003). A few experimental applications of sewage sludge in burned areas suggest that they can be used to foster the establishment of target species (Larcheveque et al.,

* Corresponding author. Tel.: +34 96 590 9731, fax: +34 96 590 9825.
E-mail addresses: a.valdecantos@ua.es (A. Valdecantos), jordi@ua.es (J. Cortina), ramonv@ceam.es (V.R. Vallejo).

0925-8574/$ – see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.ecoleng.2011.03.017