

We are unable to supply this entire article because the publisher requires payment of a copyright fee. You may be able to obtain a copy from your local library, or from various commercial document delivery services.

From Forest Nursery Notes, Winter 2011

177. © Use of waste materials as nursery growing media for *Pinus halepensis* production. Manas, P., Castro, E., and Vila, P. de las Heras J. European Journal of Forest Research 129:521-530. 2010.

Use of waste materials as nursery growing media for *Pinus halepensis* production

Pilar Mañas · Elena Castro · Pau Vila ·
Jorge de las Heras

Received: 5 May 2009 / Revised: 13 November 2009 / Accepted: 9 December 2009 / Published online: 29 December 2009
© Springer-Verlag 2009

Abstract Peat moss is gradually being replaced by other materials as a growing medium in forest nurseries due to economic and ecological constraints. In this study, six different mixtures were tested, mixing peat moss (P) and pine bark (B) with digested sewage sludge (S) activated sewage sludge (A) and paper mill sludge (M), as growing media for *Pinus halepensis* seedlings; three different waste doses were applied. Seed germination percentage, seedling growth and foliar nutrient content after 1 year in a greenhouse and percentage survival after transplanting were recorded. The influence of base substrate (P or B) on germination percentage changed in different ways according to the type of waste. The order of the different applied mixtures by suitability (germination rate and seedling growth) from best to worst was as follows: activated sludge with peat, activated sludge with pine bark, sewage sludge with peat, sewage sludge with pine bark, paper mill sludge with pine bark and finally paper mill sludge with peat.

Keywords *Pinus halepensis* · Sewage sludge · Paper mill sludge · Nursery · Germination

Introduction

Fertilization of nutrient-depleted and degraded forest soils may be required to sustain human utilization of forest resources. Thus, application of sewage sludge compost directly on soils has been tested both in forests (Meghelli 2006; Meyer et al. 2004; Valdecantos 2005) and in pastures (Mosquera-Losada et al. 2001). Biosolids from municipal wastewater sludge have been widely used over recent years (Sánchez-Monedero et al. 2004) as a soil base substrate. Another material used recently has been paper mill sludge. As is the case with sewage sludge, most studies consist of paper mill sludge application directly onto soils in order to determine the effects on plants and soils (Feldkirchner et al. 2003; O'Brien et al. 2003). However, few studies have reported on the use of these waste products for growing forest seedlings (Chong and Lumis 2002; Mañas et al. 2009). In nurseries, peat and natural soils are most commonly used as substrates for growing ornamental plants and forest seedlings. Nevertheless, these materials are being fully or partially replaced with various organic waste products such as municipal solid waste compost, sewage sludge, pine bark, sawmill residues and rice hull (Ingelmo et al. 1998). The main reason for this change is the high price of good quality horticultural peat, especially in countries without natural peat moss and the uncertain availability of peat in the near future due to environmental constraints (Abad et al. 2001). In some European countries, the application of compost is an alternative to the use of inorganic fertilizers since commercial compost production has increased and compost quality has improved (Borken et al. 2004). It has been shown that applications of sewage sludge (usually composted sewage sludge) and pine bark in different proportions can improve the growth of pine seedlings a few months after planting (Hernández-

Communicated by A. Merino.

P. Mañas (✉) · E. Castro · J. de las Heras
Departamento de Producción Vegetal y Tecnología Agraria-
CREA, Universidad de Castilla-La Mancha, Campus
Universitario s/n, 02071 Albacete, España
e-mail: mariap.manas@uclm.es

P. Vila
Facultad de Biología, Universidad de Murcia, Murcia, España