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Legume living mulch for afforestation in agricultural land in Southern Spain

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ABSTRACT

Weed control is essential for a successful establishment and growth of tree seedlings in former agricultural land. Weed control methods are effective but can be costly in terms of time, damage to non-target vegetation, or increased soil erosion. Alternatively, some living mulches can exclude undesirable vegetation, protect the soil, compete minimally with associated trees, and supplement soil nitrogen, but there is a lack of knowledge on living mulch systems in Mediterranean afforestation. Thus, the objective of the present study was to evaluate the effects on Holm oak (*Quercus ilex* L.), mastic tree (*Pistacia lentiscus* L.), wild olive (*Olea europaea* L. var. *sylvestris* Brot.) and terebinth (*Pistacia terebinthus* L.) seedlings of wrinkled medick (*Medicago rugosa* Desr.) mulch. Survival, growth, photosynthesis, foliar nutrient and soil parameters were measured during the first year. 36 months after planting, seedlings in the living mulch had survival rates of between 60% for mastic tree and 8.3% for Holm oak, compared with survival rates of 70% in the mechanical treatment for mastic tree and 2% for Holm oak. Photosynthesis and foliar nutrient concentrations were improved by the living mulch treatment. The soil under the living mulch had higher CEC, soil organic matter levels and nitrogen content in comparison to the cultivated soil. The response of living mulch differs between species and environmental conditions but our study suggests a positive effect due to soil protection. Living mulch may be a promise alternative for use in Mediterranean afforestation programs.

1. Introduction

In afforestation of former agricultural fields, herbaceous weeds are known to compete with newly planted seedlings for water, nutrients, and light (Cogliastro et al., 1990). Silvicultural practices, that are often adopted for managing ground cover, can be classified as mechanical (tilling, mowing, and grazing), chemical (herbicide applications), and physical control (synthetic weed barriers and organic mulches), used alone or in combination with tree shelters (Dobois et al., 2000; Navarro Cerrillo et al., 2005). When compared with plantings without herbaceous weed control, treated forest plantations are commonly characterized by increased plant survival and enhanced growth (Navarro Cerrillo et al., 2005; Athy et al., 2006; South and Miller, 2007). These methods are all effective, but each has its disadvantages. Furthermore, soil left bare after tillage operations can increase surface exposed to erosion forces and facilitate loss of organic matter and eventual soil structure degradation (Pimentel et al., 1995). An alternative method of ground cover management is the use of living mulches.

Living mulch is a permanent cover crop that is planted in conjunction with a tree seedling for the purpose of suppressing weed growth while also protecting the soil. Living mulch has been recognized as a beneficial practice in forest plantations (van Sambeek et al., 1986; Alley et al., 1999). This weed control system improves soil structure, increases organic matter and humus in the soil, and promotes biological activity (Dupraz et al., 1997). Thus, the utility of living mulch has been assessed in various forestry applications, including the establishment of hardwood and conifer plantations (Alley et al., 1999). Ideal living mulch should provide sufficient ground coverage to exclude other plants and compete minimally with the tree seedlings for water and nutrients. Living mulch species must be selected in order to suppress weed growth but not compete excessively with the associated tree seedlings. There are some species with an adequate phenology and morphology such as grasses (*Lolium*, *Poa*, *Agrostis*, *Festuca*, etc.), and, in particular, legumes with a short or prostrate growth habit

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