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Road Slope Revegetation in Semiarid Mediterranean Environments. Part I: Seed Dispersal and Spontaneous Colonization

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Abstract

The importance of neighboring vegetation as a seed reservoir for spontaneous colonization of adjacent road slopes was analyzed in a semiarid region of east Spain. Two independent methodological approaches were used to examine the relative contribution of seed from neighboring vegetation and the efficiency of different seed dispersal strategies in plant colonization. We first used a randomization test to compare floristic similarity between road slopes, neighboring flora, and local flora (the regional species pool found in the same climate and soil conditions as the road slopes). Second, we compared seed dispersal mechanisms of road slope vegetation with those of the surrounding area using frequency analysis. Species composition of road slopes was more similar to that of the flora of adjacent surrounding areas than expected by chance. Anemochorous (wind-dispersed) plants were over-represented in road slopes 8 years after road slopes were built. We concluded that seed dispersal from neighboring vegetation is an important factor in the vegetative colonization of road slopes. However, this initial species pool was also strongly shaped by the harsh environmental conditions of roadcuts and southern aspect. These results have important implications in road slope restoration because they suggest that naturally vegetated areas should be maintained adjacent to road slopes to enhance seed immigration from species adapted to local site conditions, which will accelerate the successional process. The application of this single reclamation strategy and mixed strategies that combine the use of natural colonization and soil amendment for road slope restoration in Mediterranean environmental conditions is discussed.

Key words: dispersion, environmental limitations, floristic composition, neighboring vegetation, randomization test, restoration, soil erosion.

Introduction

Understanding the mechanisms behind the establishment of plant communities is a significant area of research in plant ecology. Although at a regional scale species composition is primarily determined by environmental conditions, on a local scale plant assemblages are largely determined by dispersal processes (Ozinga et al. 2005). In the last decade, many studies have provided evidence that seed dispersal contributes significantly to plant colonization in different types of environments. A broad suite of descriptive studies have focused on comparisons of the floristic composition of different pools of species (local vs. regional) and on the hypothesis that the availability of diaspores and probability of their arrival at a specific site are inversely related to the distance of the diaspore source (Willson 1993). Butaye et al. (2002) pointed out that 91% of the species occurring in newly colonized forest patches in a fragmented agricultural landscape in Central Belgium were contained in the neighboring older forests within a radius of 1,000 m. In a mixed deciduous forest in Belgium, Verheyen and Hermy (2001) attributed a decline in the frequency and abundance of species with increasing distance from the colonization source to the dispersal limitation. Dzwonko (1993) obtained similar results in a fragmented agricultural landscape of southern Poland; he argued that nearby old-growth forests provided the main source of diaspores to newly colonized woodlands and that the species composition and richness of newly colonized areas were determined by their distance from old-growth forests. Moreover, in these woodlands, seed dispersal strategy greatly affected which seeds reached isolated woods; hovering and flying anemochores (wind-dispersed seeds) and endozoochores (dispersed by animals by ingestion) were the best colonizers, whereas heavy anemochores, myrmecochores (ant-dispersed seeds), and barochores (gravity-dispersed seeds) were much less successful (Dzwonko & Loster 1992).

Another suite of studies that involved experimentally adding seeds to either existing populations (seed augmentation) or unoccupied sites (seed introduction) also permitted assessment of the importance of seed availability and dispersal to the species diversity and abundance of plant communities (Primack & Miao 1992; Ehrlen & Ericksson 1996; Zobel et al. 2000; Tofts & Silvertown 2002; Foster & Tilman 2003). In all these studies, addition of missing diaspores increased the species density and

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