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Regenerating Topsoil Functionality in Four Drastically Disturbed Soil Types by Compost Incorporation

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Abstract

The low water-holding capacity and low nutrient levels of roadcuts in northern California cause many of these disturbed areas to remain chronically barren. Yard waste compost was incorporated into four nonvegetated substrates found along roadcuts (decomposed granite [DG], lahar, serpentine, and sandstone) in order to regenerate topsoil infiltration, water-holding capacity, and nutrient availability. Soil physical and chemical properties, as well as the vegetative response of a native perennial grass, were compared between treatments (non-tilled, tilled, and tilled with compost amendment). Tillage and compost addition decreased soil bulk density compared to the non-tilled treatment, and the compost treatment increased the soil carbon and nitrogen contents compared to the non-tilled and tilled treatments. Tillage alone resulted in an increase in saturated hydraulic conductivity in soils that did not contain a large amount of coarse fragments. Tillage also reduced sediment loss in all soils except the DG. Foliar C^{13} content did not predict water stress consistently between treatments. The incorporation of yard waste compost increased plant available water in coarse but not in fine-textured soils, and aboveground plant biomass was significantly greater in the compost treatment than in either of the other treatments. Although the incorporation of yard waste compost generated the greatest revegetation success, tillage alone may be a sufficient treatment if residual soils have adequate nutrient levels.

Key words: compost, disturbed soils, erosion, plant available water, revegetation.

Introduction

Road construction in the mountains of northern California has resulted in many cut and fill slopes that consist of drastically disturbed soils (all topsoil and biological activity removed; Box 1978). These slopes increase erosion potential because they are steeper than the natural relief of the land form, they break the hydrological continuity of slope drainages, and they expose the underlying parent material (cut slopes) or fractured, unconsolidated, and compacted parent material (fill slopes). The noncohesive structure along with the concentrated flows generated along roadways makes cut and fill slopes common sources of sediment. The Mediterranean climate (prolonged summer drought) of this region in combination with the poor soil resources of these disaggregated geological materials makes these roadcuts erosive and difficult to revegetate. Parks and Nguyen (1984) found erosion from a serpentine roadcut in the California Sierra-Nevada Mountains to be as much as 49 metric tons/ha annually. Road fills constructed using granitic soil materials in the Idaho batholith, which are similar to substrates found in both the north coastal and the Sierra Nevada Mountains, have been shown to produce as much as 124 metric tons/ha annually (Megahan 1978).

The California Department of Transportation works to quantify the amount of sediment produced in their right of way and to develop plans to reduce that sediment load to an acceptable level (Storm Water Prevention Plan). An effective way to reduce sediment loss is through revegetation, especially with deep-rooted perennial species. Vegetation increases infiltration, reduces sediment loss (Battany & Grismer 2000*a*; Loch 2000), and may be the most economic long-term solution for erosion reduction. Standard revegetation techniques such as hydroseeding of annual species with inorganic fertilization do little to correct nutrient deficiencies and the poor physical properties of these disturbed substrates.

Reapplication of topsoil is an effective revegetation technique (Claassen & Zasoski 1993; Larney et al. 2003); however, an adequate supply of topsoil is often not available. There is a need to develop soil amendment techniques that will regenerate the physical and chemical functionalities of the pre-disturbance topsoil (infiltration capacity, internal drainage, soil strength, root penetrability, water-holding capacity, and adequate nutrient pools) in degraded roadcut substrates. In this study, composted yard waste was incorporated into four drastically

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