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# Revegetation of steep rocky slopes: Planting climbing vegetation species in artificially drilled holes

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ABSTRACT

A method of vegetation establishment with rocky slopes was conducted by planting three climbing plant species (*Parthenocissus tricuspidata* (*Sieb.et Zucc*) *Planch*, *Hedera helix* and *Euonymus fortunei* (*f. minimus*)) an artificial hole drilled on a rocky slope surface of an abandoned quarry. During the experiment period for 18 months, plant growth and dynamics of soil moisture content in holes were surveyed. The results indicated that artificial holes may save soil on the rocky slope for plant growth, but water deficit was the key limiting factor to plant growth in the hot summer. *P. tricuspidata* and *E. fortunei* had higher survival and growth rates than *H. helix*. They showed good adaptability to the disadvantageous growing conditions of rocky slope. The experiment demonstrated that *P. tricuspidata* and *E. fortunei* could be used as pioneer plant species for revegetation of rocky slopes.



## 1. Introduction

Many quarries have been exploited to provide construction material. These earthworks generated large numbers of steep rocky slope. Past attitudes neglected rehabilitation, not only leaving extensive and unsightly scars on the landscape, but also increasing soil erosion and physical safety hazards (Jim, 2001). Natural restoration is a very slow process, which may take hundreds of years. As a result, natural restoration is not considered acceptable as a restoration strategy (Cullen et al., 1998). Artificial revegetation methods have been widely used to rehabilitate the landscape of rocky slopes (Petersen et al., 2004). Many current rocky slope restoration projects have often been carried but without proper scientific guidance due to lack of information and knowledge on plant growth and natural conditions of slope (Shu et al., 2003). Therefore, the outcome of these projects is often not very satisfactory.

The common revegetation procedure for high and steep rocky slopes includes reducing the slope angle by blasting and using the debris to build an artificial and gentler slope or platform, followed by covering topsoil, dispersing seed or hydroseeding for planting (Clemente et al., 2004; Daisuke et al., 2006; Brofas and Varelides, 2000; Montoro et al., 2000). In this procedure, blasting is necessary to avoid coast of instability slope. However, the blasting operation is difficult and dangerous, and the transportation of the resulting detritus requires a significant amount of additional work and cost (Dimitris and Dimitris, 2003). In addition, the creation of a gentler slope also demands a large quantity of soil and substrate for backfilling to the formation of a suitable artificial soil layer for vegetation. The complexity and high cost of this technique has restricted its application. Furthermore, blasting is prohibited in some locations, such as in the vicinity of densely populated areas.

Soil accumulation on the rocky slope face is a key factor for vegetation establishment in the early successional stages, but it is very difficult to retain soil on a rocky slope surface due to the direct impact of rainfall and high rates of water erosion. Therefore, the revegetation of the rocky slopes with little soil has become a challenge to restoration practitioners (Aronson et al., 1993). Herbage and shrub are the main species for revegetation on slopes (Silvia and Fernando, 2007), but other species are paid little attention about growth trend on rocky slopes. The steep rocky slope is a unique and extreme habitat, so it is necessary to select a plant that can adapt to the severe environment by certain special mechanisms and growth behavior.

In order to overcome the difficulty of revegetation on rocky slope surfaces, we proposed an innovative method that involves drilling vertical holes on rocky slope surfaces, filling the holes with soil, and then planting seedlings in the holes. Three climbing plant species,

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