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Primary succession on slopes exposed to intense erosion: the case of Vesuvius Grand Cone

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Mt. Vesuvius (1281 m a.s.l.) is an active volcano dominating the central part of the Campania Region coastline, with a distinctive barren crater summit, known as Grand Cone, formed during the eruption of AD 79. Local environmental factors hindered the colonization of the Vesuvius Grand Cone by vascular plants after the last eruptions of 1906 and 1944. The Grand Cone exhibits very steep planar slopes (33-35 degrees), covered by unconsolidated pyroclastic deposits, mainly formed by lapilli and gravels, characterized by an extremely low water holding capacity and very low organic matter and nitrogen contents, and exposed to intense water and wind erosion. In the last decade *Genista aetnensis* (Biv.) DC. (*Fabaceae*), has been expanding over the Grand Cone, facilitating the colonization by other species, especially herbaceous, with a dramatic change of the landscape appearance of the Vesuvius Grand Cone. *G. aetnensis* is a plant endemic of Mt. Etna and Eastern Sardinia and was firstly introduced at the base of Mt. Vesuvius within reforestation programs after the eruption of 1906. This plant is a nitrogen fixing species with a strong ability to colonize andosols, much more pronounced than the indigenous brooms (*Cytisus scoparius* and *Spartium junceum*). An intensive investigation has been conducted to explore the eco-hydrological processes driving the vegetation dynamics observed on the slopes of Grand Cone. Specific field surveys and laboratory experiments have been carried out to assess the effects of the *G. aetnensis* on soil physical and chemical properties, on the above- and below-ground microclimate, on the soil hydrological regime and on the distribution of coexisting species. The *G. aetnensis* triggers a pedogenetic process that contributes to a rapid increase of carbon and nitrogen stocks, available phosphorous, cation exchange capacity and a reduction of soil pH. The increase of carbon content also significantly improves the water retention properties in this coarse-textured soils, increasing the soil water content available for plants. Continuous monitoring of the microclimatic variables, both under and outside the canopy shading, reveals that the *G. aetnensis* canopy reduces the air and soil temperatures while keeping air humidity higher in the warmest hours of the day during the entire growing season, thus reducing soil water losses by evaporation. During the hottest day of the summer season, the canopy shading also mitigates the surface soil temperature maxima, which values outside the canopy shading are prohibitive for the survival of the vascular plants. Ultimately, the *G. aetnensis* creates an island of fertility under its canopy, by ameliorating the soil quality and by creating more favourable microclimate and soil hydrological conditions under its canopy, determining underneath the canopy a less stress prone environment that allows the colonization by less stress adapted species.