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护坡植物根系与岩体相互作用的力学特性

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摘要 通过野外原位拉拔试验, 选取灌木铁仔、黄荆、羊蹄甲和禾本科金发草等4种植物, 按着生点基岩风化程度不同, 测定植株的抗拔力、单根的力学特性和生物指标, 研究护坡植物根系与岩体相互作用的力学特性。试验结果表明: 受根系构型、受力单根的极限抗拉力及作用根系数量的影响, 其单根极限抗拉力随根径的增加而增大, 之间有很好的幂函数关系; 随植物类型不同, 单根的拉力-伸长率关系不同, 且极限伸长率随着根径的不同而变化, 羊蹄甲与黄荆的拉力-伸长率为线性关系, 遵从胡克定律, 而灌木铁仔的拉力-伸长率为对数函数关系, 羊蹄甲与黄荆根系的极限伸长率表现为随根径增大而降低, 铁仔根系的极限伸长率与根径的关系表现出单峰形曲线; 在地茎或株高相近的情况下, 灌木的抗拔力随基岩风化程度的加剧而增大, 在基岩风化程度相近的情况下, 抗拔力随地茎、株高及地下生物量的增加而增大, 之间具有很好的指数关系; 草本植物金发草生物指标与抗拔力之间无明显的数学关系, 与基岩间的力学作用不明显。探明根系力学作用特性随植被与基岩类型改变而改变的特征, 可为岩石边坡植被护坡工程构造设计及植被类型选择提供必要的参考。

关键词 [岩石力学](#) [抗拔力](#) [植被护坡工程](#) [生物指标](#) [力学特性](#) [拉力-伸长率](#) [风化程度](#)

分类号

MECHANICAL CHARACTERISTICS OF INTERACTION BETWEEN ROOT SYSTEM OF PLANTS AND ROCK FOR ROCK SLOPE PROTECTION

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Abstract

Four kinds of plants including *Myrsine*, *Vitex negundo*, *Bauhinia*, *Pogonatherum paniceum*, grew on according to different weathering degrees of bedrock, and were selected to measure pull-resistances, mechanical characteristics of single root and biological indexes by the in-situ pull-out experiment. The purpose is to study the mechanical characteristics of interaction between the root system of plants and rock for rock slope protection. The results indicate that the pull-resistance of shrub is impacted by configuration of the root system, maximum pull-resistance of single root and the amount of roots under stress. The maximum pull-resistance increases with root diameter increasing, and there is a good power function relationship between them. The relationship between pull force and tensile stretch of single root changes with different vegetation types. Furthermore, the maximum tensile stretch varies with different root diameters. The pull force-tensile stretch of *Bauhinia jaberii* and *Vitex negundo* is of linear relationship, which follows Hook's law, while that of *Myrsine africana* is of logarithm function relationship. The maximum tensile stretch of *Bauhinia jaberii* and *Vitex negundo* is declined with increment of root diameter. The relationship between the maximum tensile stretch and root diameter appears a unimodal curve. If the diameter at ground height(DGH) or plant height is similar, the pull-resistance of plants increases with bedrock weathering degree. If the rock weathering degree is similar, the pull-resistance and some factors such as DGH, plant height and subterranean biomass show positive correlations and present exponential function relationships. However, there is no obvious mathematic relationship between biological factors and the pull-resistance of *Pogonatherum paniceum*, and the mechanical effect between *Pogonatherum paniceum* and bedrock is not distinct. As a result, the research result can provide reference to the structural design of eco-engineering for rock slope protection (EERSP) and selection of vegetation type.

Key words [rock mechanics](#) [pull-resistance](#) [eco-engineering](#) [biological index](#) [mechanical characteristics](#) [pull force-tensile stretch](#) [weathering degree](#)

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