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A Biomechanical Study of Potential Plants for Erosion Control and Slope Stabilization of Highland in Thailand

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Abstract: Soil bioengineering provides a sustainable method for erosion control and soil slope stabilization using vegetation with multiple co-benefits. This study evaluated ten plant species in Thailand's highland regions for their soil bioengineering potential and additional benefits. Root architecture, tensile strength, and Young's modulus were measured to compare biomechanical traits. *G. sepium*, *F. griffithii*, *P. americana*, *B. asiatica*, and *C. arabica* exhibited H-type roots with wide lateral spread, while *M. denticulata* and *C. officinarum* had VH-type roots with deep taproots and wide lateral extent. *A. sutepensis* showed M-type roots with most root matrix in the top 0.3 m, where *C. cajan* and *C. sinensis* had R-type roots with deep, oblique growth. Most species showed a negative power relationship between the root strength and Young's modulus with the root diameter except *C. cajan* that showed a positive correlation. *P. americana*, *F. griffithii*, *C. officinarum*, and *C. arabica* showed relatively high values of 1 mm root tensile strength (exceeding 24 to 42 MPa), while *M. denticulata*, *G. sepium*, and *B. asiatica* exhibited intermediate root tensile strength (ranging from 8 to 19 MPa). *A. sutepensis*, *C. cajan*, and *C. sinensis* demonstrated the lowest root tensile strength, up to 7 MPa. It is advised to plan slope vegetation by selecting diverse plant species with varying root structures and benefits, addressing both engineering and socioeconomic needs of the sustainable nature-based solution.

Keywords: soil bioengineering; root biomechanics; root architecture

1. Introduction

Due to the current climate change and extreme weather conditions, land degradation and rainfall-triggered landslide are one of the most pressing environmental concerns particularly in mountainous highlands. These problems are accelerating in recent years due to land scarcity and the increasing pressure for food security that lead local farmers in highland to follow unsustainable agriculture practice such as slash and burn, associated with annual crops. In order to tackle this problem, a sustainable approach that promotes societal development while addressing economic and environmental needs is followed