

Influence of the root strength of herbaceous vegetation in forest slopes of Mexico

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1. Introduction

Soil erosion is one of the major environmental issues of Mountainous countries like Mexico. The mountainous regions are inherently unstable and prone to different types of erosion causing natural geo-hazards. The surface erosion and landslides has been major environmental problems in the forest slopes of many countries. For several years the problem of landslides processes and their interaction with erosion and deforestation have been occurring in the forest slopes of Mexico causing a considerable sum of material damages, and human lives. The application of vegetative techniques and the scientific study in erosion mitigation can be applied for road slope stabilization but the systematic study on the relationships between vegetation and erosion is very limited. The preparation and knowledge of this matter would make a great benefit for the making of decisions in the stabilization of slopes. The aim of this study is to find the pull out resistance force from herbaceous vegetation species of the forest slopes of Mexico and find which species are more suitable for erosion control.

2. Methodology and Study Area.

The study was conducted in two different sites of Mexico: 1) Iturbide, Nuevo Leon, 2) Linares, Nuevo Leon (Figure 1). In order to investigate the influence of the root strength of herbaceous vegetation the sites were delimited with parcels of 25 m². For carry out the pull out resistance force test, 30 herbaceous plants with different sizes were randomly chosen per parcel. Before carrying pull out test, soil surface around the plant was carefully cleared from litter exposing stem base. One end of a strong fine wire was tied around the stem base of the plant and another end was connected to a hand-held portable Push Pull Digital Gage AIKOH Model RX-100. The vertical force was loaded manually till plant was uprooted without mechanical damage to the root systems. In some tests, where roots were cut during extraction, tests were repeated. The peak force, at which plants were just started to break off from the soil were recorded from the digital pulling gage (Figure 2). During uprooting, it was revealed that the pull out resistive force was influenced by morphological characteristics, such as shoot height, total numbers of roots present and root sizes of an individual species.

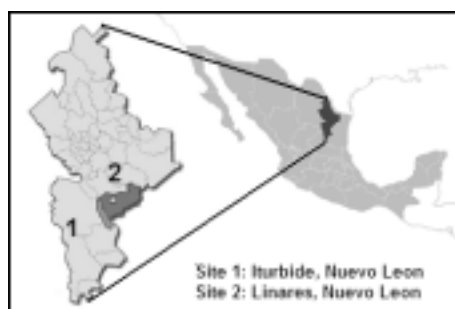


Fig 1. Location of Study Sites in Nuevo Leon, Mexico.

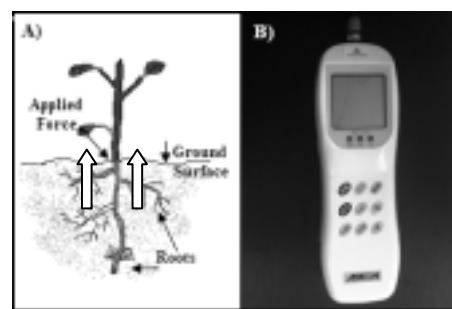


Fig 2. Schematic view of pullout experiment and instrument used. A) illustration of pull out test, B) instrument used for uprooting a plant.

3. Results and Discussion

The relationships of the morphological characteristics such as shoot height and uprooting peak resistive force were analyzed. As example the relationships between them are shown in the Figure 3. In the Site 1 (Iturbide) with species *Abutilon incanum* the maximum Pull Out Strength force of the herbaceous plants observed in the study sites ranged from 11.1 N to 115 N with a height of 15 cm and 55 cm respectively. Species *Decatropis bicolor* ranged from 13.2 N to 79.8 N with height of 38 cm and 37 cm respectively. In the Site 2 for the specie *Melochia tormentosa* the Pullout Strength Force ranged from 49.5 N to 68.7 N with a height of 43.18 cm and 40 cm. The Pull Out Strength force of the specie *Turnera difusa* ranged from 40.5 N to 90.8 N, with a height of 12.5 cm to 25 cm. The specie *Croton cortesianus* shown a range in Pull Out Strength Force of 54.5 N to 60.4 N, and a height of shoot of 35.5 cm and 39.37 cm. *Gochnatia hypoleuca* shown a range of Pull Out Strength Force of 15 N to 22 N with a height of 13 cm and 16.5 cm respectively. The specie *Salvia filipes* show a range of Pull Out Strenght Force of 33.8 N to 32.5 N with a height of 24.13 to 20.5 cm. *Hibiscus cardiophyllus* shown a range of 14.1 N to 91.1 and a height of 17.89 cm and 35.56 cm respectively.

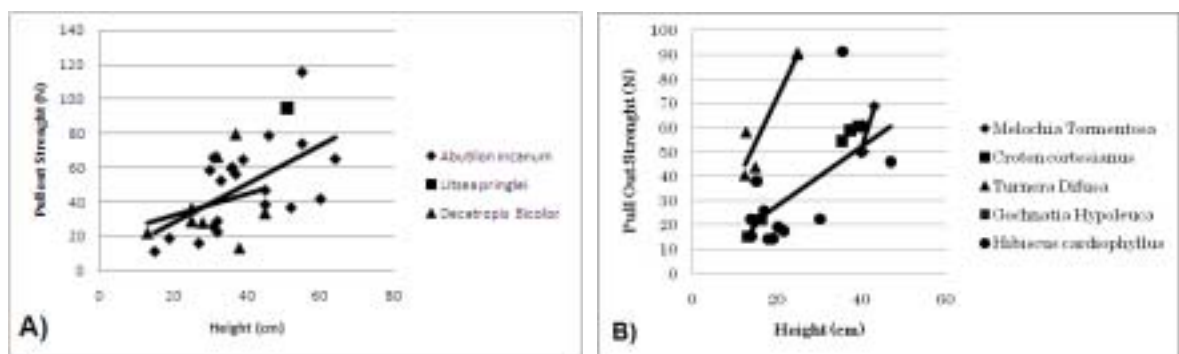


Figure 3. Relationship between Height (cm) and Pull Out Resistance Force (N). A) Site 1: Iturbide, Nuevo Leon. B) Site 2: Linares, Nuevo Leon.

4. Conclusion

The study of the herbaceous vegetation root systems might be a good indicator to know the site quality in eroded area, subsequent erosion state and to examine the relationships between plant and soil. The understanding of this matter can be very useful for erosion control and to decrease the negative impacts on forest slopes, such as surface erosion or landslides. This study evaluated the Pull Out Strength force of herbaceous plants of the forest slopes of Mexico and the data obtained from it revealed that Pull Out Strength Force was determined by the combined morphological features of the plants like height, root morphology. The maximum species observed in Iturbide Nuevo Leon (site 1) was *Abutilon incanum* with 115.8 N and in the site 2: Linares, Nuevo Leon the maximum Pull out resistance force observed was of 91.3 N with the specie *Hibiscus cardiophyllus*. The pullout resistive strength of the plants is an important step in examining strength of an individual species in erosion processes.

Reference

Devkota B. et al. 2006. Revegetation Condition and Morphological Characteristics of Grass Species Observed in Landslide Scars, Fukuoka, Japan. Journal of Applied Sciences, pp 2238-224.