EGU General Assembly 2020

Copernicus.org
Meetings & Open Access Publications

Mechanical Properties of Native Tree Species for Soil Bioengineering in Northeastern Mexico

Rebeca Zavala[1], Israel Cantú[1], Laura Sánchez[1], Humberto González[1], Eduardo Estrada[1], and Tetsuya Kubota[2]

1 Autonomous University of Nuevo Leon, Faculty of Forest Sciences, Nuevo León, Mexico
2 Faculty of Agriculture, Kyushu University, Fukuoka Japan.

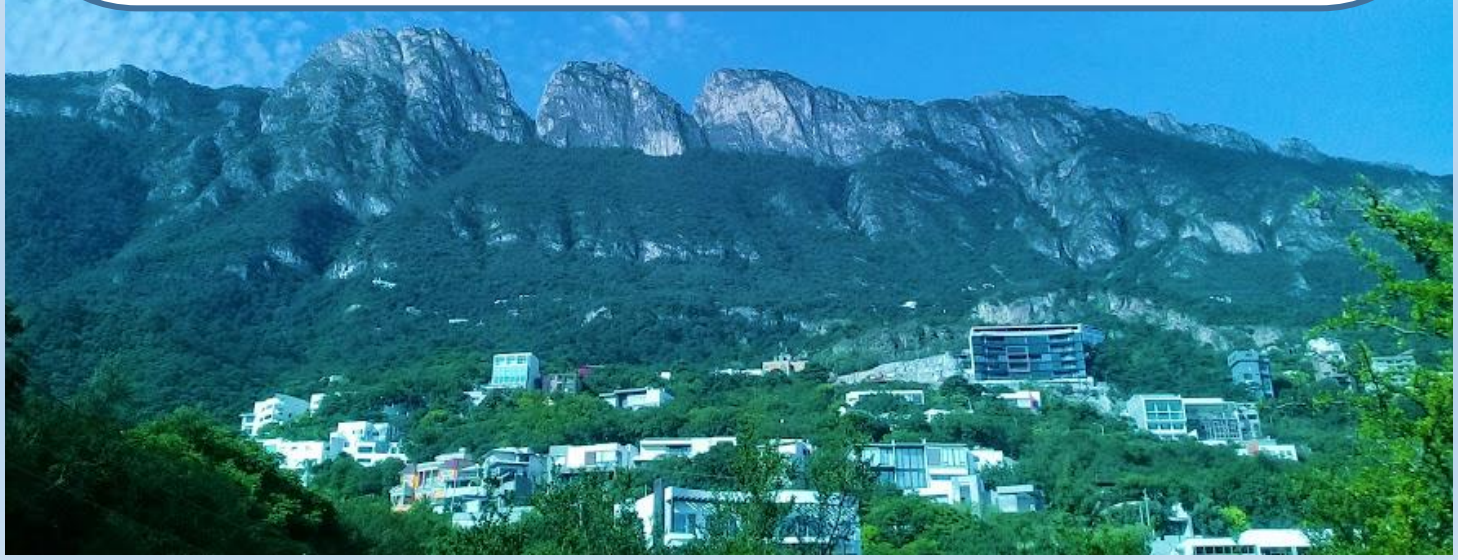
INTRODUCTION

Vegetation increases protection and decreases erosion in urbanized forest areas. The application of vegetative measures to restore the affected sites could be significant as they are ecologically friendly, low in costs, and easy in techniques (Sánchez-Castillo 2015).

In northeast Mexico, in the urban areas near the mountain range, there are problems with landslides and debris flow.

The government and the landowners hardly enter mutual agreements to address such issues. For this reason, a proposal would give to landowners the option of planting native trees to mitigate the slope instability problems that may arise in their lands. A fundamental resource to achieve the above is to consider plant species that have the potential to grow in steep sites

Zavala et al., 2019



MATERIALS AND METHODS

2 *Selection* of species

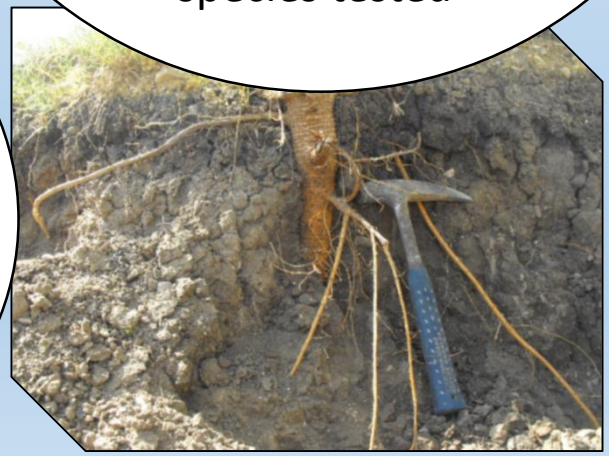
Native characteristics: natural distribution, abundance and presence in hillside areas

3 *Sampling method*

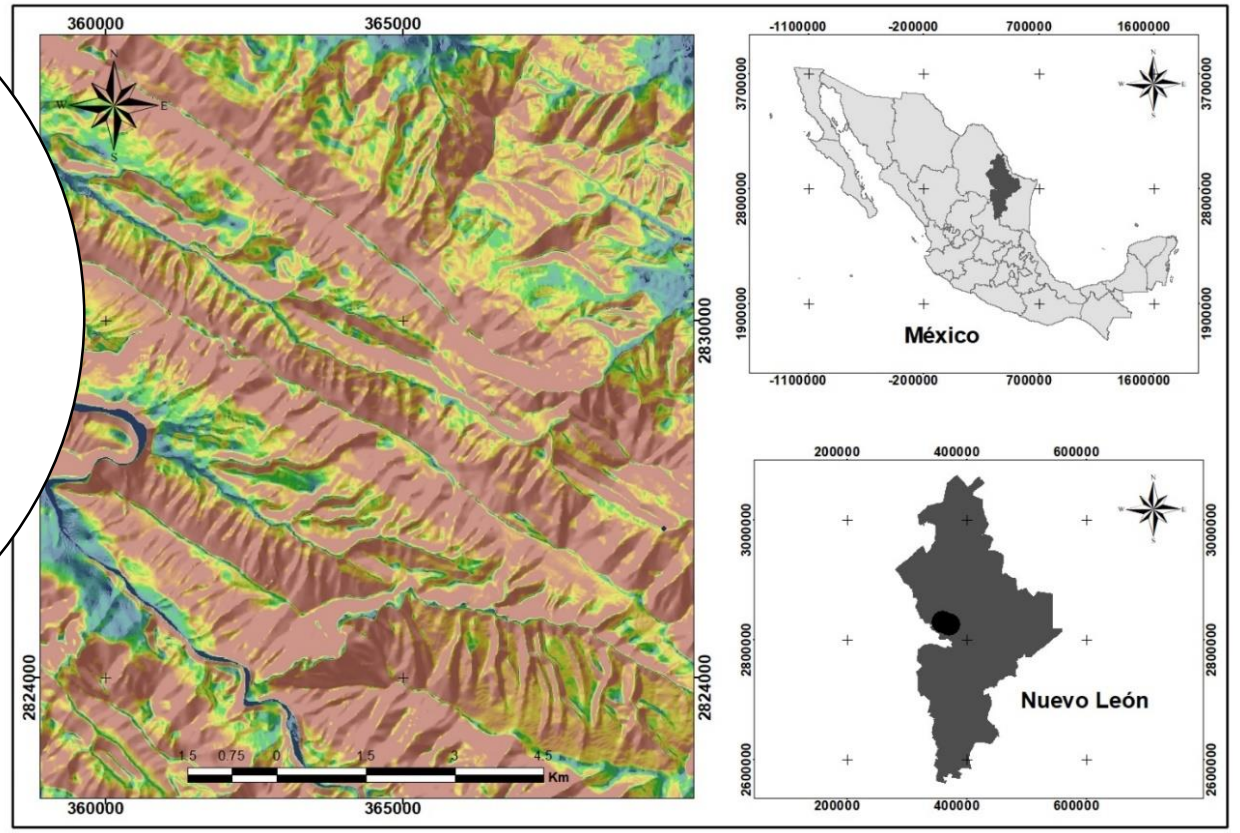
The individuals were randomly selected with approximately five meters of minimum distance between them. Fifty root samples per species from an exposed root system were extracted, sampling five individuals per species from each of the ten species tested

4 *Preparation of root samples for analysis*

Roots were extracted from exposed root systems. Then at laboratory, damaged roots were discarded, and the root samples were classified by diameter range



1 Study *area*



Localization of study area on flanks of Chipinque Mountain in Nuevo León.

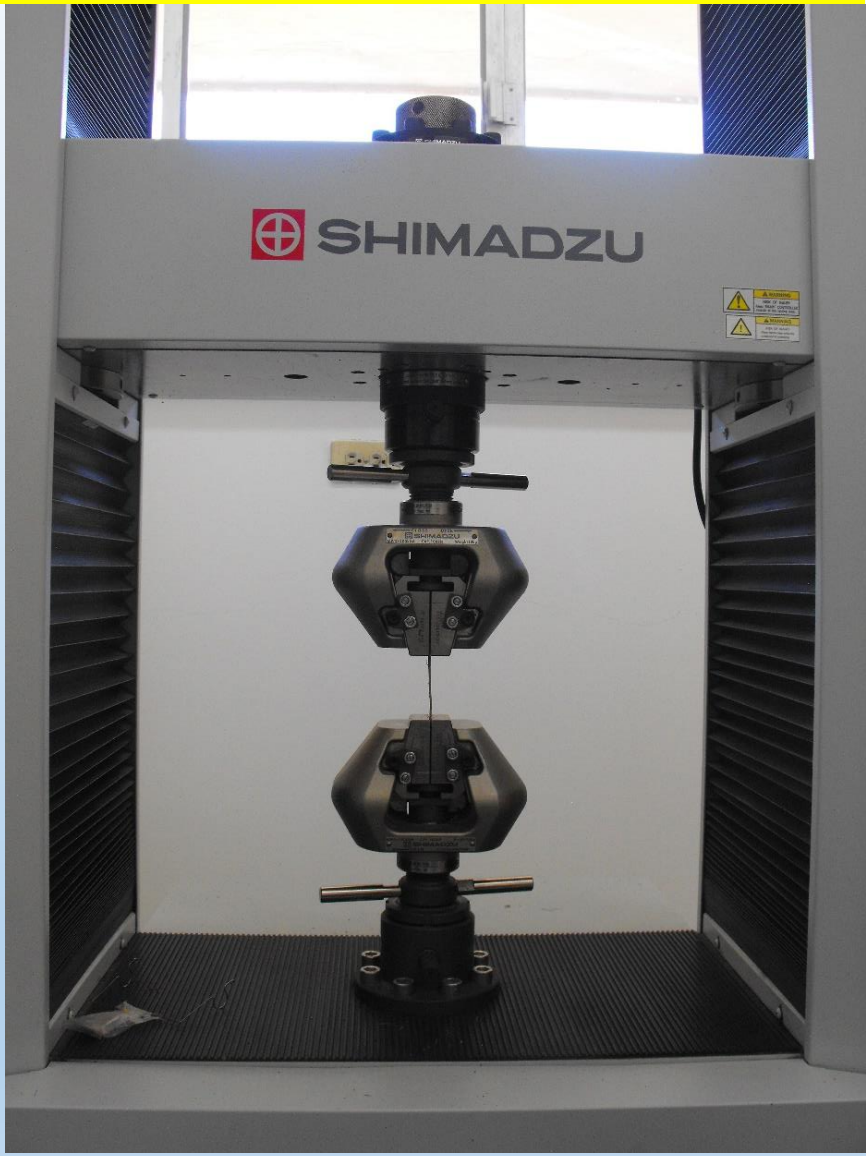
5 *Tensile strength test*

Test were carried out using a Universal Testing Machine SHIMADZU type SLFL-100Kn.

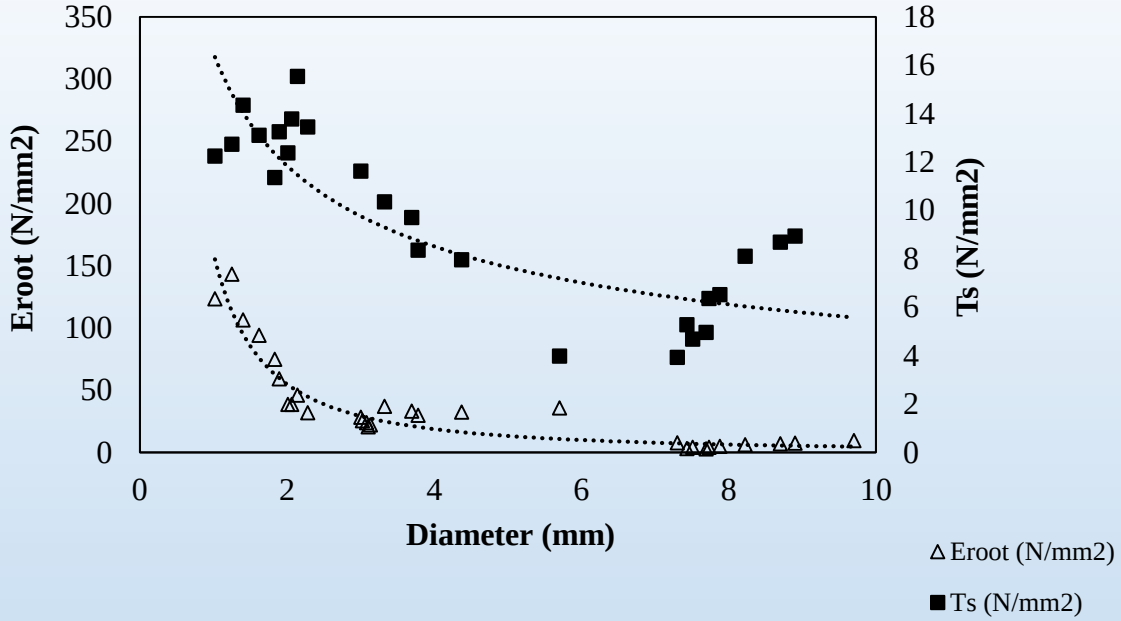
Data was visualized using the material testing operation software Trapezium.

$$Ts = Fmax/\pi(D/2)2$$

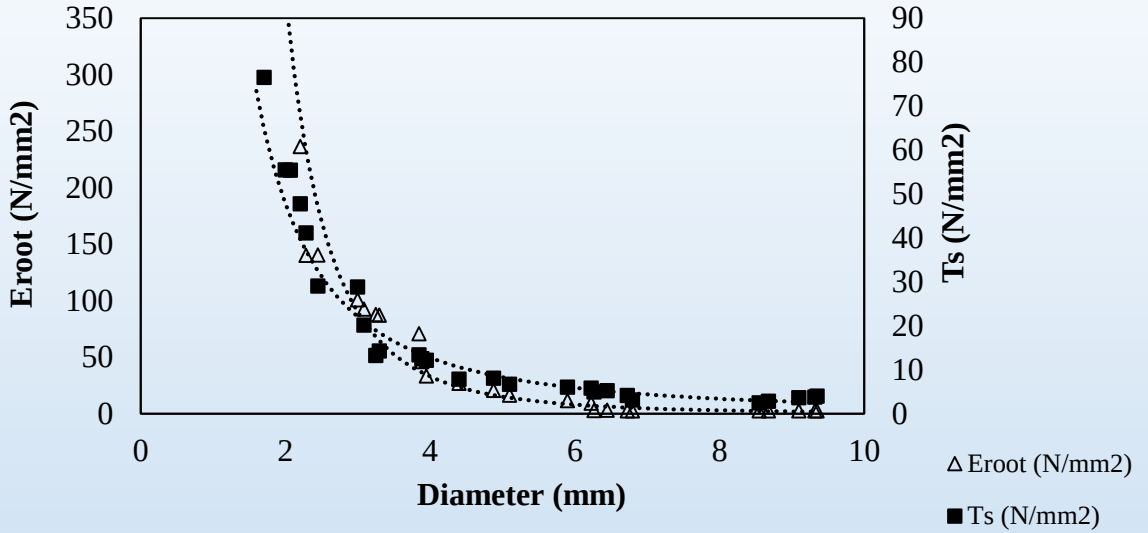
$$Eroot = (Fmax/A0)\ CE/L0$$



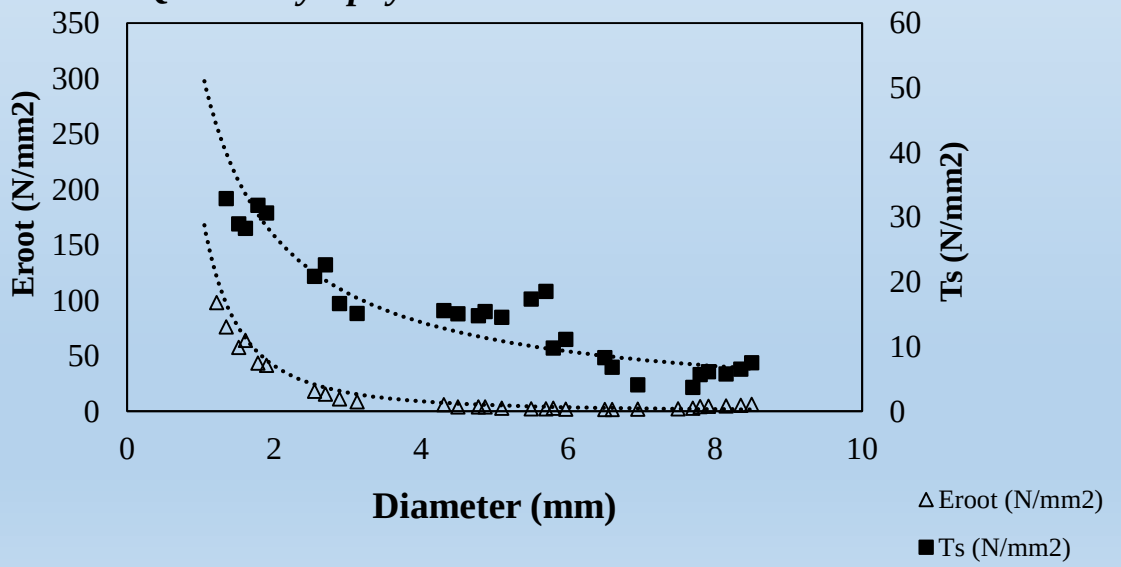
Cercis canadensis



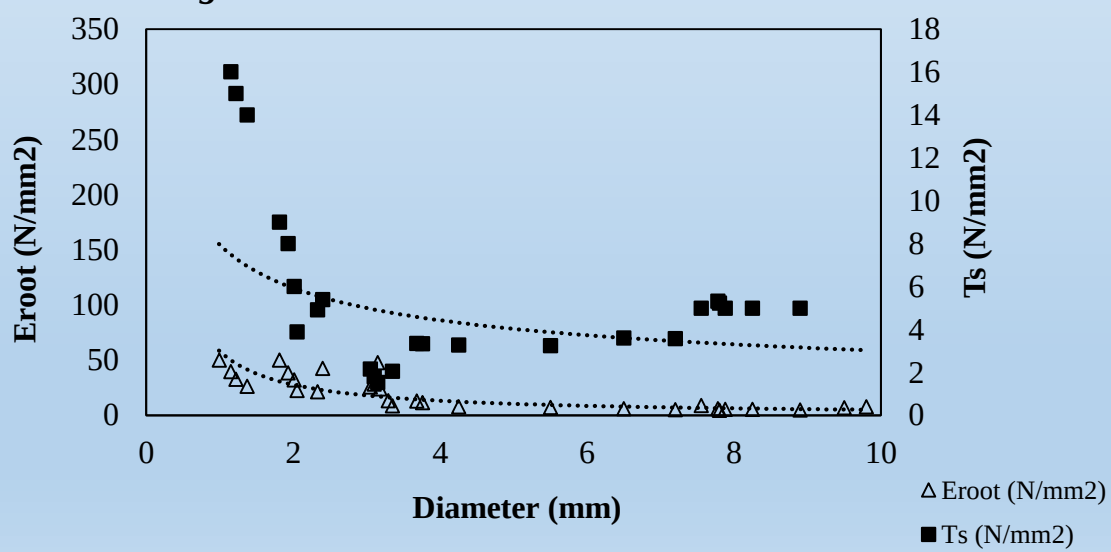
Celtis laevigata



Quercus rysophylla



Ligustrum lucidum



RESULTS

RESULTS

The relationships among root diameter, tensile strength (T_s), and modulus of elasticity (E_{root}) was negative and could be fitted with a power regression equation, showing highly significant values $p<0.01$.

Celtis laevigata showed the maximum value of tensile strength (T_s) 28.11 N/mm^2 while the minimum value of tensile strength was observed in *Ligustrum lucidum* 5.27 N/mm^2.

For the variable modulus of elasticity (E_{root}) C*eltis laevigata* showed the maximum value of 90.01N/mm^2 while the minimum value of modulus of elasticity was observed in *Ligustrum lucidum* 29.16 N/mm^2.

CONCLUSIONS

Mechanical proprieties are showed the following ascending order: *Ligustrum lucidum* < *Quercus rysophylla* < *Cercis canadensis* < *Celtis laevigata*.

Likewise, *Celtis laevigata* showed the highest tensile strength and modulus of elasticity of all investigated species.

BIBLIOGRAPHY

Bischetti, G.B., Chiaradia, E.A., Epis, T., Morloti, E., 2009. Root cohesion of forest Species in the Italian Alps. *Plant Soil*, 71-89. DOI: 10.1007/511104-009-9941-0

De Baets S, Poesen J, Reubens B, Wemans K, De Baerdemeaker J, Muys B. 2008. Root tensile strength and root distribution of typical Mediterranean plant species and their contribution to soil shear strength. *Plant Soil* **305:**207–226. DOI: 10.1007/511104-008-9553-0

Gray DH. Sotir RB. 1996. Biotechnical and Soil Bioengineering Slope Stabilization: A Practical Guide for Erosion Control. 35-37. New York: John Wiley & Sons.Improvement **4**:81–89.DOI:10.1680/grim.2000.4.2.81

Pollen N. 2007. Temporal and spatial variability in root reinforcement of steambanks: accounting for soil shear strength and moisture. *Catena* **69:**197-205. DOI:10.1016/j.catena.2006.05.004

Pollen N, Simon A. 2005. Estimating the mechanical effects of riparian vegetation on steam bank stability using a fiber bundle model. *Water Resources Research* **41:**1-11. DOI: 10.1029/2004WR003801