Geophysical Research Abstracts,
Vol. 10, EGU2008-A-03965, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-03965
EGU General Assembly 2008

Rooting of trees in earth dykes: morphology of tree root systems on slope and risks for embankments

C. Zanetti, M. Vennetier, P. Meriaux, P. Royet

Cemagref, Aix-en-Provence, France

caroline.zanetti@cemagref.fr / Fax: +33 (0)4 42 66 88 65 / Phone: +33 (0)4 42 66 99 56

Keywords

Tree root system architecture, earth embankments, dykes safety, slope stability.

Objectives

Although the positive effects of woody root systems on slope stabilization were shown many times (Nilaweera and Nutalaya 1999; Abernethy and Rutherfurd 2000; Norris and Greenwood 2003; Danjon, Barker and al. 2007; Reubens, Poesen and al. 2007) these conclusions are however not directly transposable with the cases of dykes.

Trees' rooting in earth dykes generates two types of risks: internal erosion which is related to root existence in earth embankments, and external erosion (slopes and crest) which is often related to trees uprooting (Sorrel, Marks et al. 2005; Mériaux and Royet 2007). In order to characterize the incidence of woody root systems on the structure and the durability of the embankment dykes, it is necessary to observe the characteristics of woody root systems for representative species (poplar, black locust, oak, ash, maple).

Methods (short description)

The acquisition of knowledge on woody root systems architecture established on dykes requires pulling up the trees. Thirty one stumps embedded on canal dykes of the Rhone River (average slope of 30 - 50 %), were excavated with mechanical shovels. Detailed observations and both manual and digital (with short range terrestrial laser

device) measurements of the architectural characteristics of the stumps were carried out.

Results

Internal erosion risk

- the root structure depends on the tree species, stumps' age, type of materials constituting the dyke (texture, structure, compaction, fertility), on the conditions for the access to water and on trees' position on dyke;

- a root typology was defined according to the architectural characteristics of the measured roots (length, rate of diameter decrease, branching);

- the presence of large horizontal roots crossing perpendicularly the embankment and of large taproot respectively generates a risk of piping and the creation of sinkholes at the time of roots decomposition.

Uprooting risk (qualitative results)

- root architecture is influenced by the slope: woody roots are generally concentrated in upslope direction;

- the tapering root systems have a tearing-up strength clearly higher than the superficial tracing root systems;

- a dense network of surface roots increases soil cohesion locally;

- roots' tensile strength varies according to species: for the same diameter, the roots of black locust are characterized by more elasticity while the roots of ashes break more easily.

Bibliographie

Abernethy, B. and I. D. Rutherfurd (2000). "The effect of riparian tree roots on the mass-stablilty of riverbanks." Earth Surface Processes and Landforms **25**: 921-937.

Danjon, F., D. Barker, et al. (2007). "Using 3D plant root architecture in models of shallow slope stability." Structural root architecture on slopes(special issue): 43.

Mériaux, P. and P. Royet (2007). Surveillance, maintenance and diagnosis of flood protection dikes - A practical handbook for owners and operators, Quae :162.

Nilaweera, N. and P. Nutalaya (1999). "Role of tree roots in slope stabilisation." Bulletin of engineering geology and the environment **57**: 337-342.

Norris, J. and J. Greenwood (2003). Root reinforcement on unstable slopes in North-

ern Greece and Central Italy. An International Conference on Problematic Soils, Nottingham, United Kingdom.

Reubens, B., J. Poesen, et al. (2007). "The role of fine and coarse roots in shallow slope stability and soil erosion control whith a focus on root system architecture : a review." Trees **21**: 385-402.

Sorrel, S., D. Marks, et al. (2005). Technical manual for dam owners - Impacts of plants on earthen dams. F. E. M. Agency, Us Department of Homeland Security**:** 115.