Bern University of Applied Sciences
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HAFL Master's Thesis Abstract

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English Title: **Root system analysis of the tree of heaven (*Ailanthus altissima* (Mill.) Swingle) and its reinforcement to the soil**

English Summary:

The tree of heaven (*Ailanthus altissima* (Mill.) Swingle) is a very aggressive and invasive neophyte species which, in recent times and especially in the south of the Alps and in low Mesolcina, has developed well and is creating many problems for indigenous forest ecosystems. After a disturbance event (for example a forest fire or a storm) the tree of heaven can quickly resettle at the expense of the indigenous species. Because of the difficult nature to fight against it (almost every intervention leads to a positive response of the tree with a massive production of root suckers), an alternative way to cohabit with it and to utilize it should be considered. One possibility is to employ the tree of heaven as an alternative to indigenous species (e.g. *Castanea sativa*) to reduce and stop different natural hazards (landslides, rockfalls). The main objective of this study is to quantify the root reinforcement of *Ailanthus altissima* in order to evaluate its contribution to the mitigation of shallow landslides.

The present study analyzes the roots architecture of *Ailanthus altissima* trees at different development stages that are situated in four different study sites within central Ticino and low Mesolcina (Switzerland). Three different methods to analyze the horizontal and the vertical root distribution have been applied. The first is the trench wall method, whereby three soil profiles are dug at different distances to the tree stem center (1.5 m, 2.5 m and 3.5 m). All the visible roots within the profiles are measured. The second method is a complete excavation of one candidate and the third method is the examination of a trench profile within a regeneration stand. In the regeneration trench, all the roots of the regeneration trees are recorded. The lateral and the basal root reinforcement of the tree of heaven is calculated using the RBMw model (Root Bundle Model Weibull).

Ailanthus altissima, compared to indigenous tree species like for example sweet chestnut, has a lower developed root system. Most of the roots are generally confined to the upper soil layers (up to 45-60 cm) and more concentrated near the tree stem (soil trench profile 1.5 m). The extension of the root system can be described as inhomogeneous and the horizontal distribution is influenced by the trees development stage. The number of roots with a diameter up to 3.4 mm usually decreases with the increase of the tree stem diameter. On the other hand, trees with a bigger stem diameter often have more thicker roots than trees with a smaller stem diameter. The growing site characteristics could also play a role in the root architecture of the tree of heaven. Favorable conditions seem to allow the

root system to better extend in width and depth.
The lateral root reinforcement provided to the soil by *Ailanthus altissima* is higher than its basal root reinforcement. As the majority of roots do not reach the shear surface, the basal root reinforcement does not play an important role in the mitigation of shallow landslides. The lateral root reinforcement decreases with a decreasing tree stem diameter and with an increasing distance to the tree stem center. As it seems that the root architecture is influenced by the site characteristics, the root reinforcement would be influenced as well.
Compared to the lateral root reinforcement of an average forest stand in Ticino (15 kN/m), the lateral root reinforcement of *Ailanthus altissima* is low. In a hypothetical pure *Ailantus altissima* mature stand with a mean tree stem diameter of 30 to 60 cm and a tree density of 200 trees/ha, the approximate lateral root reinforcement is 0.8 kN/m. Therefore, *Ailanthus altissima*, in all its development stages, is not a good alternative to indigenous tree species regarding mitigation of shallow landslides.

Keywords: Root reinforcement, *Ailanthus altissima*, Shallow landslide, Root architecture

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