GreenLogix

ABSTRACT

Vegetation control on roads and railroads

The structural influences on road and rail vegetation

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Green Logix Abstracts

In the area of transport infrastructures, spontaneous vegetation is exposed to a considerable safety risk and combated by chemical or mechanical means. Glyphosate is one of the most widely used agents worldwide. Glyphosate is harmful to the environment and to health; As a result, alternative and environmentally friendly solutions are being researched in many places.

The project objective is to control vegetation along roads and rail-ways. The research consortium consists of the following companies: E.C.O. Institute of Ecology, biohelp, University of Applied Sciences (UAS) Technikum Wien, Carinthia University of Applied Sciences (CUAS). During the project period methods of: Alternative/ecological vegetation control, mechanical vegetation control and chemical vegetation control were tested and investigated by the consortium.

The Green Logix project shows that there are many effective alternative methods of vegetation control available. Each of these methods can have a different effectiveness. The applicability of each method also depends on the field of application.

E.C.O. Institute of Ecology

The Austrian Federal Railways (OEBB) and the Autobahnen- und Schnellstraßen-Finanzierungs-Aktiengesellschaft (ASFINAG) pledged to stop using Glyphosate as their main weedkiller. Together with partners from different fields of activity, a trans-disciplinary research project over a period of three year was launched to test a variety of methods to reach this goal. Those methods consist of different alternative herbicides with different compositions and active substances, alternative mechanical approaches as mowing, mowing and mulching and electro weeding. Additionally, a variety of ecological approaches have been tested. Two different seed mixtures where tested on their eligibility to reduce regular maintenance efforts on the areas outside the actual train track. Furthermore, several different substrates used in the construction of railway tracks where set up in test boxes to check on their ability to supress or delay the sprouting of weeds. E.C.O. Institute of Ecology was tasked with the ecological accompaniment of said methods at the test site in Breitenlee, Vienna.

After assessing the vegetational status quo, the methods where applied and their effects on vitality and growth of the vegetation were recorded on fixed plots. By comparing the initial vegetation cover before and after the application it seems that the herbicide-mix „Nozomi, Chikara, Dominator Ultra, Wetcit 0,2%" achieved the best result by reducing the cover by up to 99% for a couple of months. Notably, all herbicides achieved cover reduction of at least 73% whereas mechanical methods like mowing or mowing and mulching only achieved a reduction of 37% at the most. However, these methods were not supposed to reduce vegetation coverage but the maintenance frequency and intensity. Electro weeding was even less efficient but could have a better impact on the vegetation cover if the area is mown first. That way, the electrodes get in contact with and can therefore damage more plants. It is, however, very reliant against the field horsetail (Equisetum arvense).

The seed-mixture test revealed that there are possibilities to reduce maintenance where they can be applied for safety reasons. Also, the more diverse mixture should be preferred as it seems to be more resilient against environmental stress such as heat, draught and mowing due to a high share of low growing herbs.

Analysis of the vegetation records of the test boxes comparing the influence of different substrates on the germination capacity have shown various results.

Only a minor share of seeds germinated, with a tendency to better germination rate under shady conditions. Additionally, data revealed that germination rate is low on coarse material with a low water holding capacity und nutrient availability.

Carinthia University of Applied Sciences (CUAS)

The aim of the project partner Carinthia University of Applied Sciences (CUAS) was to develop and test mechanical methods of vegetation control for roads and rail-ways.

In the course of the Green Logix project, the Carinthia University of Applied Sciences tested out various mechanical methods for vegetation control on rail and roadways at various test sites in Austria. Six different geotextiles and fleeces were tested in Vienna and Linz. The geotextiles are intended to reduce the growth of vegetation as much as possible. The fleeces are particularly suitable for use in the renovation and construction of new infrastructure.

The analysis of the plant growth with different rock materials and recycling products was a part of the research of the Carinthia University of Applied Sciences. For this purpose, test boxes with different rock materials - different types of track ballast and recycled products - were filled and observed. The germination and growth behavior of the emerging plants on the different substrates was systematically documented. The analysis of plant growth in connection with different rock materials and recycling products with different test arrangements (exposures, contaminations with organic components) is the main objective of this work. The hypothesis of this research paper is: To what extent does the rock material influence the plant growth? Is there a correlation between petrography and plant height?

In order to answer the research questions, a test arrangement with 36 test boxes was started in Villach. In the test boxes where 12 different rock materials in diverse arrangements tested. The following materials were installed: granite, diabase, basalt, limestone, crushed sand, recycled asphalt, recycled concrete. The following insights were gained in the course of the scientific test sites. Large aggregates are more resistant to fouling than mills. Pure material is more antifouling than impure material. Diabase is more growth-inhibiting than granite. Recycled asphalt is more growth-inhibiting than recycled concrete. Crushed stone is more growth-inhibiting than limestone slate. The experiment could show that there is a significant correlation between petrology and growth behavior.

University of Applied Sciences (UAS) Technikum Wien

The control of unwanted plant growth on roads and railway tracks using herbicides is essential, as otherwise the manual effort of road and track maintenance would increase excessively. It is important to consider the possible effects and impacts of herbicides on the environment and human health. This ranges from acute effects such as poisoning of non-target organisms to long-term accumulation and changes in biodiversity.

During the Green-LOGIX project (vegetation control on roads and railroads), it was the aim of the University of Applied Sciences (UAS) Technikum Wien to perform an ecotoxicological assessment of various selected herbicides. For this purpose, a test battery was selected, which includes tests according to OECD guidelines for the determination of acute toxicity on embryos of the zebrafish Danio rerio (OECD Guideline No. 236; Fish embryo toxicity test [FET]), on the fibroblast cell line BALB/c 3T3 from Mus musculus (OECD Guideline No. 129, Neutral red uptake assay [NRU]) and on algae of the species Raphidocelis subcapitata (OECD Guideline No. 201; algal growth inhibition assay [AGI]). Various mixtures of the herbicides biohelp Finalsan® Plus, Touchdown Quattro, Nozomi, Valdorflex, Chikara and the adjuvants Wetcit, Karibu, Grounded and various size fractions of the weed barrier BSW (BSW Regupol growth-inhibiting mat type 767) were tested. Test results were used to create dose-response curves and thereof EC50 values for the different formulations were calculated.

Comparisons of the EC50 values of Touchdown Quattro (NRU: 0.73 g/L, AGI: 0.45 g/L, FET: 0.038 g/L) and biohelp Finalsan Plus (NRU: 1.37 g/L ,AGI: 0.37 g/L ,FET: 0.21 g/L) showed that Touchdown Quattro was more toxic to cells and fish embryos than biohelp Finalsan® Plus. This was not the case for algae. The EC50 values of the

herbicides Valdorflex, Chikara and Nozomi indicate very weak to absent toxicity to cells and Danio rerio embryos but showed very strong toxicity to algae. Tests with the Regupol growth-inhibiting mat type 767 showed no acute toxicity on any of the model organisms.

Based on the results obtained and available information from already published literature, biohelp Finalsan® Plus with the active substance pelargonic acid and maleic acid hydrazide for the usage on railways is recommended. Pelargonic acid exhibited the lowest toxicity and the lowest persistence (< 1 day) compared to the active substances of the other formulations tested (e.g. persistence of glyphosate: 15-1000 days).

biohelp

The aim of the project partner biohelp was to develop effective alternatives to the currently applied methods of weed control on railway tracks and in communities.

Pelargonic acid products as well as herbicides already approved for use on railway tracks and herbicides with current approval in agriculture, and combinations of these, were tested on railway tracks. In most cases, a wetting and penetration agent was added to the spray mixture to increase its effectiveness. The currently applied standard mixture of the Austrian Federal Railways (ÖBB) consisting of two herbicides (active ingredients glyphosate and flazasulfuron) achieves 100% efficiency in one spray per year with a water requirement of 200 litres/ha. The two most economical alternatives (a mixture of foliar and soil herbicides, or and a growth agent) reached efficiencies between 94 and 96 % and needed about 2.5 times the amount of water of the standard mixture in one application per year. An alternative (foliar, soil herbicide, growth agent) with 98 % efficiency requires 4 times the amount of water for 2 sprays per year; two alternatives with 100 % efficiency require 5 times the amount of water for 2 sprays per year. The price of all these alternatives is ten times higher than that of the currently used mixture.

Only pelargonic acid products have been tested in communities. Depending on the intensity of weed growth and the species composition of the weed flora, the products achieved very good to poor efficiencies on gravel surfaces after 2 sprays per year. Very good efficacy was observed on newly laid gravel paths with predominantly dicotyledonous perennial herbs. On gravel surfaces with high compaction, a high proportion of grass or a high proportion of area-covering perennial herbs, regulation was difficult. Repeated applications on one and the same area over several years would probably increase the long-term control.