

Hot water treatment: an alternative solution for vegetation control on railway tracks

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Introduction

Glyphosate is currently the only herbicide permitted in Switzerland for vegetation control on railway tracks and grounds. The Swiss Federal Railways (SBB) uses it as sparingly as possible. The zone of intensive maintenance includes the track area (Fig 1D). Unwanted vegetation is treated by spraying teams with back-pack sprayers (11 track kilometers per day). This enables the targeted removal of unwanted vegetation, while keeping glyphosate consumption low and avoiding run-off. Nevertheless, the use of herbicides has a negative impact on the environment. The SBB has set itself the objective of abandoning the use of glyphosate for track maintenance and controlling weeds using more environmentally friendly methods. One of the most promising alternative methods is to use a hot water spray train. The SBB has developed a test vehicle that has a sensor for plant recognition and sprays hot water at the plants to be destroyed. The hot water spray train has already completed its first test runs as part of a pilot project. Results are presented here.

Results

The efficiency of the individual treatments varied between 74.1 and 99.6% (Table 1, Fig 2 and 3), which allows us to classify them from moderate to very good effects (Table 1) according to European standards.

In total 59 plant species were detected on the railway tracks. *Geranium robertianum* was the most common species and the HW treatments had only a partial effect. *Taraxacum officinale* and *Crepis sp.* small plants could be successfully treated by HW (Fig 3). However, some larger plants survived the treatments. The only woody species recorded was *Acer campestre* and the plant was not eliminated by the HW treatments.

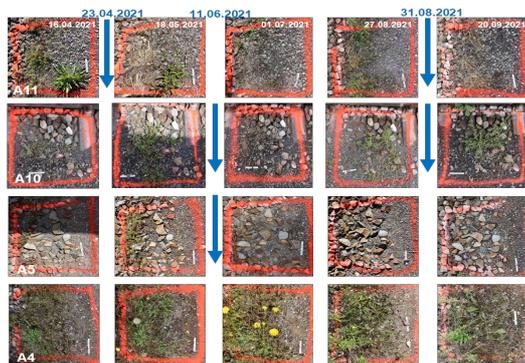


Fig 2: Overview of the vegetation development in a counting frame during 2021. A picture was taken (white date) before and after each hot water treatment (blue arrow).

Rail track number	04.2020	05.2020	09.2020	04.2021	06.2021	08.2021
A11	NT	NT	NT	74.1	failed	98.2
A10	80.5	98.5	96.2	NT	91.4	89.6
A5	97.2	82.7	77.2	NT	99.6	NT
A4	94.5	NT	NT	NT	NT	NT

Table 1: Efficiency (%) of the HW treatments. Vegetation was monitored on four rail tracks. Track A11 was the untreated control in 2020. Track A4 was treated with glyphosate in 2020 and the untreated control in 2021. In blue, efficiencies of the HW treatment (%), in red efficiency of the glyphosate treatment, (NT, Non treated).



Fig 4: On the left: rail track A4, 1 month after glyphosate treatment, on the right: rail track A4 after the 2nd hot water treatment (30.06.2020).



Fig 1: Photos of the hot water spray train (A, C), the surveyed area in Muttenz, CH (B) and an example for the treated track area (D).

Methods

Hot water (HW) treatments: Verges (1m large) on both sides of the ballast bed (Fig 1D) were treated with hot water (85-90°C) with a nozzle pressure of 2 bars (Fig 1C). The estimated amount of water sprayed was 5-10 l/m² and the train speed was between 5 and 10 km/h. The sensor for plant recognition was not activated during those assays.

Botanical survey: Before and after each HW treatment, a survey of the plants present on the verges next to the ballast bed was carried out (Fig 1D). Based on the vegetation present in April 2020, three 10-meter sections were selected on each of the verges to the left of the tracks (Fig 1B). In addition, 3 counting frames (0.25 m²) were positioned in each 10-meter section and marked. This made it possible to count and identify all plants species present at the same places within the frames throughout the entire trial. Efficiencies refer to the number of larger plants/m² and were calculated using the Henderson-Tilton formula.



Fig 3: *T. officinale* plants after HW treatments (2020). Some plants may have adapted to the HW (A). Red arrow indicates formed seeds. Most plants were killed by the HW (B, C and D).

Summary

The Swiss Federal Railways (SBB) developed a hot water spray technology, which was tested over three years (2019-2021). The effectiveness of the treatment was superior to 80%. In terms of efficiency, hot water treatment represents a good alternative to glyphosate treatment, however this study does not take into account the economic and energy aspects, nor the feasibility of setting up the hot water treatment system on a railway network.