Controlling the spread of invasive species with innovative methods in road construction and maintenance.

Controllroad is financed by the CEDR Transnational Road Research Program Call 2016 “Biodiversity - Conflicts along the Road: Invasive Species and Biodiversity”
Aim of the project

1. Creation of a list of invasive alien plant (IAP) for European countries with relation to traffic
2. Test new methods for IAP management
3. A best practice-guide for the control of IAP during road construction and maintenance
4. Cost benefit analysis for the implementation of new methods during road construction and maintenance
5. Develop a best practice guide for road construction and maintenance
Transport and invasive alien plants

- IAP are introduced accidentally or deliberately into environments where they are not normally found and cause serious negative consequences in the new environment.

- Traffic plays an important role in the spread of IAPs.

Ragweed distribution among Lower Austria (data NFB project LS12-016)
EU REGULATION (EU) No 1143/2014

Prevention and management of the introduction and spread of invasive alien species

Management measures should avoid any adverse impact on the environment as well as on human health

Cross-border cooperation needed

Early detection needed

Eradication measures should be effective in achieving the complete and permanent removal of the population of the invasive species concerned with due regards to human health and the environment, especially non-target species and their habitats
Minimize the spread of invasive alien plants on roads

IAPs related to roads and the spread among road

Publication/booklet based on literature search

Alternative methods for IAP management

Field test on alternative methods for the management of IAP

Current practice on road construction, operation and maintenance in regards to IAP

Questionnaire/ cost benefit analysis

Recommendation for best practice to prevent IAP spread
<table>
<thead>
<tr>
<th>Genus</th>
<th>Species</th>
<th>Family</th>
<th>Origin</th>
<th>according to BioFlor</th>
<th>according to EPPO Global database</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acer</td>
<td>negundo</td>
<td>Aceraceae</td>
<td>North America</td>
<td>Eschen-Ahorn</td>
<td>box elder</td>
</tr>
<tr>
<td>Ailanthus</td>
<td>altissima</td>
<td>Simaroubaceae</td>
<td>Asia</td>
<td>Drüsiger Götterbaum</td>
<td>Tree-of-heaven</td>
</tr>
<tr>
<td>Ambrosia</td>
<td>artemisiifolia</td>
<td>Asteraceae</td>
<td>North America</td>
<td>Beifuß-Ambrosie</td>
<td>Ragweed</td>
</tr>
<tr>
<td>Asclepias</td>
<td>syriaca</td>
<td>Apocynaceae</td>
<td>North America</td>
<td>Echte Seidenpflanze</td>
<td>common milkweed</td>
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<tr>
<td>Buddleja</td>
<td>davidi</td>
<td>Scrophulariaceae</td>
<td>Asia</td>
<td>Gewöhnlicher Sommerflieder</td>
<td>butterfly bush</td>
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<tr>
<td>Fallopia</td>
<td>japonica</td>
<td>Polygonaceae</td>
<td>Asia</td>
<td>Japanischer Flügelknöterich</td>
<td>Japanese knotweed</td>
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<tr>
<td>Fallopia</td>
<td>x bohemica</td>
<td>Polygonaceae</td>
<td>Hybrid</td>
<td>Bastard-Flügelknöterich</td>
<td>Bohemian knotweed</td>
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<td>sachalinensis</td>
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<td>Asia</td>
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<td>giant knotweed</td>
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<td>tuberosus</td>
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<td>Topinambur</td>
<td>Jerusalem artichoke</td>
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<td>Heracleum</td>
<td>mantegazzianum</td>
<td>Apiaceae</td>
<td>Caucasus</td>
<td>Riesen-Bärenklau</td>
<td>giant hogweed</td>
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<tr>
<td>Impatiens</td>
<td>glandulifera</td>
<td>Balsaminaceae</td>
<td>India</td>
<td>Drüsiges Springkraut</td>
<td>Indian balsam</td>
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<tr>
<td>Populus</td>
<td>x canadensis</td>
<td>Salicaceae</td>
<td>Hybrid</td>
<td>Kanadische Pappel</td>
<td>Canadian poplar</td>
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<td>Robinia</td>
<td>pseudoacacia</td>
<td>Fabaceae</td>
<td>North America</td>
<td>Gewöhnliche Robinie</td>
<td>black locust</td>
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<td>Rudbeckia</td>
<td>lasiniata</td>
<td>Asteraceae</td>
<td>North America</td>
<td>Schiltzblatt-Rudbeckie</td>
<td>cut-leaved coneflower</td>
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<tr>
<td>Senecio</td>
<td>inaequidens</td>
<td>Asteraceae</td>
<td>South Africa</td>
<td>Schmalblättriges Dreikraut</td>
<td>narrow-leaved ragwort</td>
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<td>Solidago</td>
<td>canadensis</td>
<td>Asteraceae</td>
<td>North America</td>
<td>Kanadische Goldrute</td>
<td>Canadian goldenrod</td>
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<tr>
<td>Solidago</td>
<td>gigantea</td>
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<td>North America</td>
<td>Riesen-Goldrute</td>
<td>giant goldenrod</td>
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<td>Symphyotrichum</td>
<td>lanceolatum</td>
<td>Asteraceae</td>
<td>North America</td>
<td>Lanzett-Herbsttaster</td>
<td>panicled aster</td>
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</tbody>
</table>
Requirements for alternative control methods

- No chemicals
- Energy efficient
- Effective in term of time and eradication
- Integration in current management praxis
- Safe for humans and the environment
- Ideally specific for each IAP
Which root zones are effected by different weed control methods?

- Infrared
- Hot air/steam
- Hot water
- Mechanical
- Chemical
- Electroherb
- Biological
## Methods on the market

### Pro and contra

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Equipment type</th>
<th>Number of treatments 2005 2006</th>
<th>Mean number of treatments year⁻¹</th>
<th>Working width (cm)</th>
<th>Working speed km h⁻¹</th>
<th>Mean dose kg gas ha⁻¹</th>
<th>Mean dose year⁻¹ kg gas ha⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flames</td>
<td>HOAF weemaster, hand pushed</td>
<td>6 6</td>
<td>5.0</td>
<td>50</td>
<td>0.64-0.70</td>
<td>150</td>
<td>750</td>
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<tr>
<td>Hot air/flames</td>
<td>Zacho Turbo Weedblaster</td>
<td>7 4</td>
<td>5.5</td>
<td>65</td>
<td>0.53-0.61</td>
<td>335</td>
<td>1.473</td>
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<tr>
<td>Steam</td>
<td>Dan-steam + handheld</td>
<td>6 5</td>
<td>5.5</td>
<td>50</td>
<td>0.50-0.60</td>
<td>163</td>
<td>897</td>
</tr>
<tr>
<td>Hot water</td>
<td>Waipuna hand held</td>
<td>4 2</td>
<td>3.0</td>
<td>20</td>
<td>1.00</td>
<td>312</td>
<td>936</td>
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<tr>
<td>Glyphosate</td>
<td>Hand held</td>
<td>2 3</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Rask et al. 2013 Determining treatment frequency for controlling weeds on traffic islands using chemical and non-chemical weed control. Weed Research 53,249-258
Literature review on the best non-chemical method on the market for roads

- All alternative methods lack speed
- Infrared most effective, but no machinery for the use on roads exists
- Steaming in experiments showed good results
- Laser radiation and freezing destroy only the upper parts of the plants
- Microwaves high energy needed
- Biological substances (like perchlorate acetic acid, acetic acid, oils) too expensive and destroy only the upper part of the plants
Zasso method: electric circuit for weed control

1. Mechanical energy
2. Transformation into electrical power
3. Production of high frequency and high voltage
4. Electricity current flows through the stem
5. Electricity current flows through the root
6. Current flows through the soil
7. Electrical earthing applicator
8. Closing the electronic circuit

Soil organism not affected, only if the weather is very wet
Natural enemies are applied periodically in high concentration when the weed causes the problem.

Examples (no products in Europe):
- BioChon (*Chondrostereum purpureum*) against *Prunus serotina*
- Camperico (*Xanthomonas campestris* pv. *poae*) for *Poa annua* in bent grass golf courses

Selective for specific weeds but registration costs too high for companies because of the small market.

Support from the public is needed.
Biological control of invasive plants on the example of *Prunus serotina*

**Problem:**
Listed invasive species in The Netherlands
Introduced in the 17\textsuperscript{th} century as a ornamental tree form Northern America
Problem: Shows a powerful regeneration
Reduction of the tree cost intensive

**Solution**
Natural occurring fungi *Chondrostereum purpureum*;
silver leaf disease
Saprophyte living on dead wood
Does not infect trees only through fresh open wounds
In experiments in the Nederland 90\% of the stumps died in two years

Photos: http://www.waldwissen.net/waldwirtschaft/schaden/invasive/lfe_waldschutz_traubenkirsche/index_DE
Important factors for effective control of IAPs

• Consistency of effort over time more important than quality
• Recognition of IAPs before road construction starts
• European wide action plant
• Re-cultivation of the native flora
• Early detection and control best strategy
Recognizing invasive alien plants and mapping their location

Application concept for mobile phones to help road construction and maintenance

Recognition  Localization  Eradication
Output:

• Which methods are suitable to combat IAPs
• What is the cost-benefit of the implementation of new methods
• How the native flora can be preserved
• Concept tools for the recognition of IAPs and their localisation

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