Asian knotweed

(*Reynoutria* spp.)

Experiments in mechanical removal of invasive alien knotweed in France, Switzerland and Germany

Concept.Cours.d'EAU SCOP (CCEAU)

- CCEAU is an environmental consulting firm specialised in riparian vegetation and invasive plants, with its headquarters in the town of Sainte-Hélène-du-Lac (Savoie department).
- The main missions include:

- assessing the invasion stages of various plants along rivers;
- formulating management strategies for invasive plants;
- managing work sites using mechanical equipment to uproot Japanese knotweed;
- providing training and raising awareness on how to manage invasive plants;
- conducting R&D work on invasive plants.

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Centre for Agricultural Bioscience International (CABI)

- CABI is an international organisation active in agricultural and environmental R&D work.
- The competence centre based in Delémont (Switzerland) is specialised in biological control of invasive alien species (IAS).
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Experimental research programme

- A programme of applied research was set up by CCEAU (initial trials from 2005 to 2009) and then expanded in a partnership with CABI (2010 to 2013).
- The objective was to run full-scale trials to develop a non-chemical technique to eliminate stands of Japanese knotweed (*Reynoutria* spp.) by destroying the rhizomes.
- The study was conducted in three steps:

- grinding of the colonised soil and laying of a black, plastic tarp until the Japanese-knotweed rhizomes had completely decomposed;
- formulation of indicators used to check the effectiveness of grinding techniques ensuring the most rapid decomposition possible;
- assessment of the decomposition time under the tarp.
- évaluation de la durée de décomposition sous la bâche.

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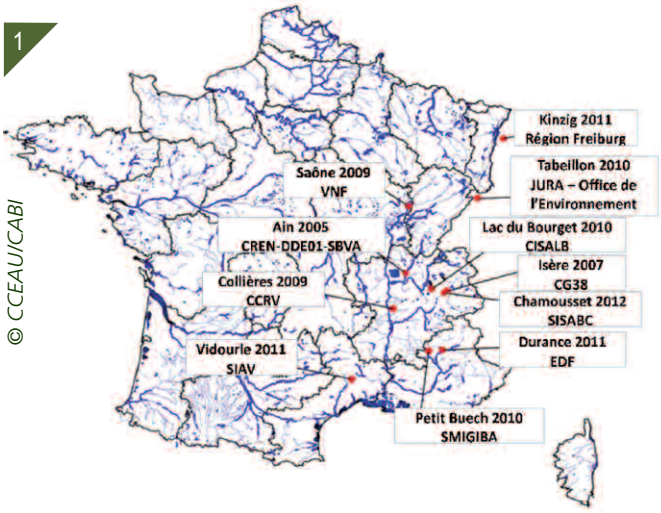

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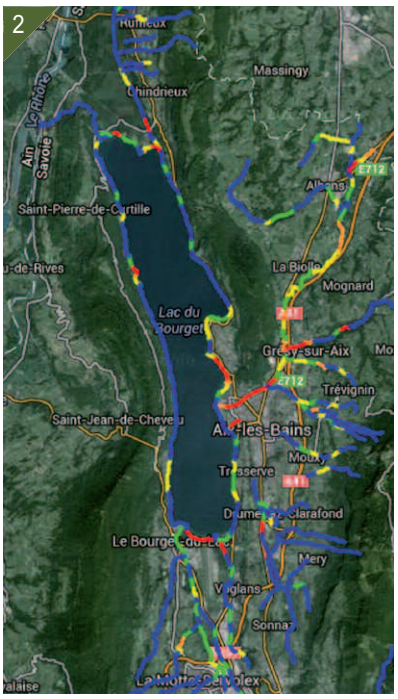

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1. Study sites (2005 to 2012).
2. Map showing the invasion stages of Japanese knotweed around Lake Bourget in France.

- *No Japanese knotweed was observed during the inspection.*
- *Rapid intervention is required before the plants have colonised large areas. * A high priority must be assigned to techniques capable of completely eliminating the plants or isolating the infested areas.*
- *Complete elimination of the plants in the sector would already appear unfeasible for technical and/or financial reasons, but management techniques could significantly slow the speed of colonisation.*
- *The sector is already heavily invaded, but it would still be worthwhile to slow the invasion by hindering the establishment of new plants growing from disseminated propagules.*
- *There is no longer any point in attempting to slow the natural colonisation of the river. However, local management work may be conducted on certain sites to handle specific requests concerning a particular use, hydraulic problems or remarkable sites.*

Intervention site

- From 2005 to 2013, the research programme was set up on eleven experimental sites in Eastern France, Switzerland and Germany.
- The trials were made possible thanks to a partnership with local participants where the managers proposed the sites and provided the funding. CCEAU and/or CABI developed the experiments and monitored them.
- The sites were selected to ensure a wide range of conditions (soil types and climate) in order to check whether the plant reacted in the same manner on all sites to the mechanical technique.
- Technical feasibility was tested during actual field trials addressing problems such as access, water levels, flood risks, bank stability, infested waste and the impact of large machines.
- The solutions found for all the above difficulties resulted in the progressive development of a precise method protocol.

Disturbances and issues involved

- Knotweed can cause numerous problems on the banks of continental aquatic ecosystems. All the trials carried out were also designed to meet the specific needs of local stakeholders in terms of management or development work.

Ecological impacts

- Reduced biodiversity in terms of both species and habitats.

Impacts on river management

- The presence of the plants creates major technical constraints during work and maintenance on rivers.

Impacts on crops

- Reduced yields and/or available land.

Impacts on land use

- The plants can significantly hinder certain activities (access to river banks).

Interventions

- The objective of the research programme was to develop a mechanised management technique for Asian knotweed.
- The technique consisted of grinding the colonised soil and then covering it with a black, plastic tarp until the rhizomes fully decompose.
- This technique was initially tested in 2005 and improved in 2007. The initial results were presented in an article published in 2009 by CCEAU.
- During the development work, it was possible to determine the decomposition time of the rhizomes (and consequently the time the tarps had to remain in place) and to devise an indicator used to check the effectiveness of the grinding work

3. Reynoutria *spp.*
4. Grinding the infested soil using a bucket grinder.
5. A black, plastic tarp is placed over the ground soil.

■ Mechanised technique

■ The soil colonised by the plants is excavated.

■ The soil containing the Japanese-knotweed rhizomes is then ground using different types of equipment depending on the local conditions (bucket grinder, stone crusher, pulvimixer). The soil may be ground on the excavation site or transported to a site specifically for grinding.

■ The ground soil is covered with a black, plastic tarp until the rhizomes have completely decomposed.

■ Numerous precautions intended to avoid dispersal of the knotweed were included in the method protocol and in the technical specifications for the companies involved. Compliance was checked by the project manager.

■ Monitoring during the work

■ To determine the time that the tarp must remain in place, the decomposition rate of the rhizomes was observed according to a number of successive monitoring protocols. The final protocol is presented below, in the section titled *Assessment and practical applications*.

6. Stone crusher.
7. Grinding bars installed on a bucket grinder.

Results and assessment

■ Effectiveness of the grinding process

■ To achieve rapid and complete decomposition, grinding of the soil must produce a significant and uniform effect on the knotweed rhizomes, i.e. the rate of damage must exceed 90%.

* Comparison between stone crushers (high rotor speed) and bucket grinders (low rotor speed):

- grinding is more effective with tractor-mounted stone crushers in that the resulting average length of the rhizomes is shorter;
- grinding the soil twice using a stone crusher is enough whereas it must be sent through the bucket grinder several times to achieve a sufficiently uniform result;
- use of additional grinding bars on bucket grinders (for soil with a low clay content) produces shorter rhizome lengths and significantly increases productivity because the soil does not need to be ground as many times.

■ Time the tarp must remain in place

■ Decomposition rates on different sites vary depending on the humidity:

- under wet conditions (water-saturated soil), the time required is between 26 and 34 weeks;
- under dryer conditions, the time required is between 48 and 70 weeks.

Length of rhizomes after grinding as a function of the equipment used and the number of grindings on sites where 100% plant mortality was achieved. Source: Concept.Cours.d'EAU

Tool	Number of grindings	Average length of rhizomes (cm)	Standard deviation
Stone crusher	2	7.9	4.4
Bucket grinder	2	6.5	4
Bucket grinder	2	10	3.3
Bucket grinder	5	10.4	5.6
Bucket grinder	3	12.2	4.8
Bucket grinder	5	13.1	7.6
Bucket grinder	2	13.2	6
Bucket grinder	1	14	8.2
Bucket grinder	1	16	8

Length of rhizomes after grinding depending on whether grinding bars are used to improve the process. Source: Concept.Cours.d'EAU

Grinding bars	Number of grindings	Average length of rhizomes (cm)	Standard deviation
No	1	21.4	10
Yes	1	15.2	9
No	2	14.1	7
Yes	2	11.5	7
No	3	13.8	5
Yes	3	10.1	6

Assessment and practical applications

■ The "grinding-tarping" process eliminated the plants completely and relatively rapidly (less than two years). On all the experimental sites assessed to date, the mortality rate was 100% (no regrowth), except in Switzerland where the tarp was removed too soon (after 51 weeks).

■ This technique can handle specific situations such as the need to protect a recently colonised hydrographic network or the need to prepare infested soil for later use.

■ The experimental results were used to produce an indicator capable of determining the effectiveness of grinding by equipment with low rotor speeds (bucket grinders), thus ensuring rapid and complete decomposition of rhizomes thanks to a sufficient number of passages through the grinder.

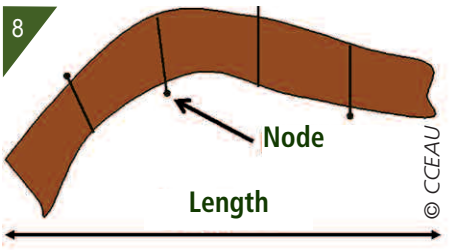
■ The indicator is based on the average length of the rhizomes after grinding of the soil:

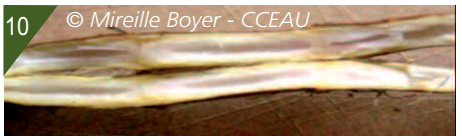
- five samples of ten rhizomes are measured to the millimetre, not taking into account the natural curves (see Figure 7);
- grinding is sufficient when the average length of the rhizomes is 14 centimetres, with a maximum standard deviation of 6 cm.

■ The tarping period is difficult to predict.

■ If the site owner is not in a hurry, it is best to leave the tarp for at least 18 months.

■ Otherwise, it is necessary to set up a monitoring system for plant decomposition using control rhizomes to determine whether the tarp can be removed without any risk of regrowth:





8. Diagram of a rhizome.
9. Collecting the control rhizomes.
10. The tissue of control rhizomes (a live rhizome on top, a dead rhizome below).

- bury to a depth of 20 centimetres five burlap bags each containing ten control rhizomes that are fresh and not ground (5 rhizomes with one node and 5 with two nodes). The minimum diameter of the control rhizomes should be 9 to 15 millimetres;
- set up visual markers or use a GPS device to locate the control rhizomes;
- place detectable netting between the tarp and the soil in order to find the buried bags;
- prepare as many sets of five bags as planned tests (12 months later, 14, 16, etc.);
- cut through the tarp and dig up the soil to recover the bags;
- cut the control rhizomes lengthwise;
- determine the decomposition status by observing the colour of the tissue (white = rhizome still alive, brown/purple/black = somewhat decomposed, totally black = rhizome is dead).

Information on the project

■ Data and know-how are traded with river technicians during technical meetings:
- Seine-Normandie water agency (River meetings in Château Renard) in May 2008;
- AGRIDEA (Maintaining river banks) in September 2009;
- ARRA (Managing and controlling Japanese knotweed) in June and September 2010;
- ARLR (Management and control strategies for invasive plants) in June 2011, Aveyron departmental council (Strategy and control methods for Japanese knotweed in rivers) in September 2011;
- symposium in Dijon (LIFE project for streams) in June 2009;
- symposium in Saint-Étienne (Japanese knotweed) in October 2012.

■ Presentations during training sessions (IFORE, ATEN, Rhône Valloire intermunicipal association, CISALB).

■ Drafting of detailed reports on experimental work sites and dissemination to the concerned managers.

■ Internet site presenting management techniques for Japanese knotweed: www.cceau.fr

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For more information

■ Internet site of Concept.Cours.d'EAU SCOP:
www.cceau.fr
■ Internet site of the Centre for agricultural bioscience international:
www.cabi.org
■ Internet site of Mireille Boyer:
http://reynoutria.japonica.pagespersoo-range.fr/