# Asian knotweed

***(Reynoutria* spp.)**

## Industrial composting to avoid dissemination of Asian knotweeds. Study on the survival of stalks, rhizomes and seeds (Savoie department)

### Savoie department

■ The Savoie Departmental Council has 2 500 employees active in a wide rang of sectors, including the social sector, education, territorial planning, the environment, culture, etc.

■ Since 1990, it has assisted the local governments in managing rivers and aquatic environments in general via the observatory on environmental quality, technical and financial aid for river restoration and maintenance programmes, and management trials for invasive alien plants.

■ Since 2005, the Council has been active in informational, prevention and management efforts concerning invasive alien species in the framework of maintenance work on its property and departmental roads, in a partnership with the concerned local governments.

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### Concept.Cours.d'EAU (CCEAU) SCOP Aquabio

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

■ Its main missions include:

- assessing the invasion stages of various plants along rivers in view of setting up action plans to avoid their dissemination;
- monitoring work sites using mechanical equipment to remove Japanese knotweed;
- providing training and raising awareness on how to manage invasive alien plants;
- research and development work on management methods for invasive alien plants.

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### Study context and goals

■ Numerous amenity centres now refuse the green waste from management operations because they are aware of the high impact of Asian knotweeds and want to avoid any risk of dissemination. This is because very little data is available on the survival rates of the plants when treated using processes such as industrial composting.



*1. What solution for knotweed cuttings when they cannot be left on site?*
*2. What should be done with a rhizome drawn from a reed bed (Bourget Lake)?*

■ In the Savoie, this situation has created problems for site managers who do not know what to do with the green waste that is, in some cases, collected in large quantities.

■ In order to assess the risks of dissemination after composting, the Savoie department initiated an experiment to determine the survival capabilities of different parts of Asian knotweed plants during composting.

■ The objective was not to develop a system to eliminate the rhizomes, but to study the risks created by their presence in green waste produced by cutting or uprooting the plants. Due to their woody composition and their contact with the soil, rhizomes are not accepted by composting units.

## Intervention site

■ The experiment was carried out at the composting unit of the Grand Chambéry metropolitan board with the assistance of the SUEZ Organique company, the site manager. The unit composts approximately 15 000 metric tons of green waste from local parks and gardens, each year.

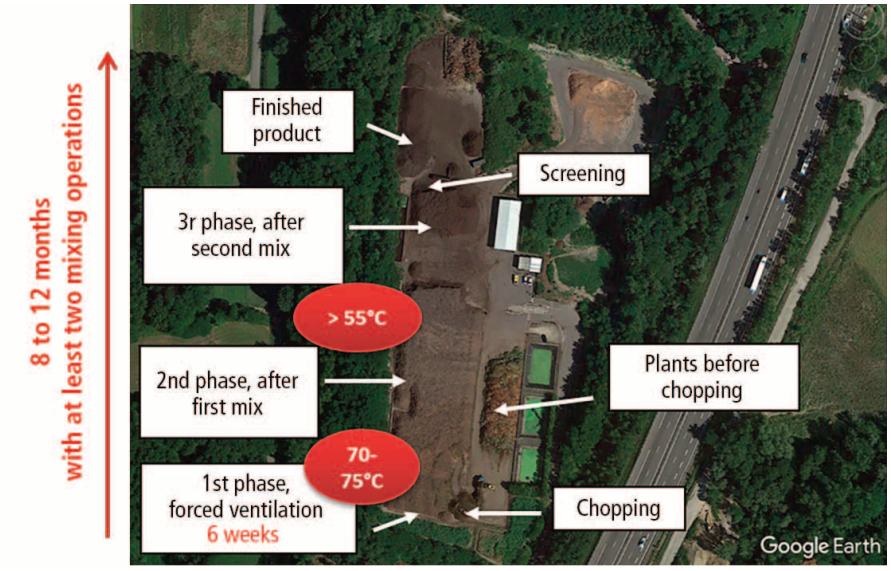
■ The composting process lasts eight to twelve months and includes a number of phases:

- chopping the plants;
- storage in long mounds with forced ventilation for six weeks to provoke temperature rise in the compost up to 70-75°C;
- at least two mechanical mixing sequences to oxygenate and homogenise the compost;
- screening the compost at the end of the process.

■ The stalks and rhizomes of the Asian knotweed were collected and transported by the departmental council. The rhizomes were collected in the town of Villard-Léger, on a site that had been colonised for several years with a high density of rhizomes in the soil. The stalks were collected in the town of Viviers-du-Lac.

■ The seeds were collected by Concept.Cours.d'EAU on a bar in the Isère River that had also been colonised for years and where the development of seeds had been observed.


*3. Green waste undergoing composting at the Grand Chambéry composting unit.*




*Aerial view of the Grand Chambéry composting unit, showing the different phases of the project.*

## Disturbances and issues involved

■ Asian knotweed produces great quantities of biomass, in some cases over ten tons of dry matter per hectare. Its growth is rapid with the stalks surging up to ten centimetres per day in the spring and reaching three to four meters in height. On certain colonised sites intended for specific purposes, the knotweed must be cut several times per year (three to five times on average). Manual uprooting is also an option for plant management.

■ As a result, regular upkeep of sites colonised by knotweed produces considerable quantities of green waste, consisting essentially of the aerial parts of the plants, but also of rhizome fragments pulled out from the below-ground parts of the plants. If the plants are cut late in the season (August and September), there may also

be seeds in the green waste. This waste cannot always be left on site, due either to the specific purpose intended for the site or to the risks of dispersal.

■ The reproductive capabilities of Asian knotweed via vegetative multiplication are exceptional. In that it can also reproduce via the seeds, it was necessary to assess the risks of dispersal via composting units before selecting the technique as a means to dispose of the plants.

## Interventions

■ The experiment consisted of injecting the stalks, seeds and rhizomes of Asian knotweed in an industrial composting process to study their mortality during the treatment and to determine the risks of species dispersal following composting.

■ The test was carried out at full scale, i.e. by integrating a large quantity of the plants in the production cycle for compost and by studying the survival rates of propagules and seeds over a complete cycle, lasting eight months. The inclusion of the plants in the compost cycle made it possible to take into account the diversity of parameters affecting the mounds and those of the rhizomes, which can be more or less long and woody, i.e. more or less degradable. The experimental conditions were set such that the plants systematically encountered the most favourable situation for their survival.

■ For practical reasons related to the seasons and the development of the plants, the experiment took place in two main steps:

- December 2016 to October 2017, composting of the rhizomes and seeds;
- June 2017 to February 2018, composting of the stalks.

### ■ Composting of the rhizomes and seeds

■ The rhizomes were collected using a backhoe and then sorted manually. A total of ten cubic metres of rhizomes were harvested.

■ They were mixed with 40 cubic metres of fresh compost, i.e. the rhizomes represented 20% of the overall volume.

■ The mix then received over one million seeds and was sent to the production line.

■ The batch containing the rhizomes and seeds was ventilated for six weeks and then remixed mechanically at three months and six months into the production cycle.

■ The total cycle lasted eight and one-half months.

### ■ Composting of the stalks

■ Seven cubic metres of stalks were cut manually. The stalks were mixed with 28 cubic metres of fresh compost, i.e. the stalks represented 20% of the overall volume. The mixture was then sent to the production line.

■ The batch was ventilated for six weeks and the remixed mechanically at three months into the production cycle. A second remix, at six months, could not be carried out for technical reasons. The forced-ventilation system was restarted to oxygenate the mound that could not be mixed.

■ The total cycle lasted eight months.

### ■ Monitoring and assessment

■ Measures were taken throughout the experiment to limit the risk of dispersal of the plants, including the presence of the consulting firm each time the plants were handled or mixed, inspections and cleaning of machines, scraping of the topsoil, markers indicating the position of the knotweed, tracing of each batch, etc.



*4. Ten cubic metres of rhizomes were collected, ranging widely in age and diameter.*
*5. A mixture of rhizomes and fresh compost.*

■ During the mixing procedures, the experimental batches were not mixed more than one metre beyond the markers for the knotweed in order to avoid dispersing the plants further in the mound. This nonetheless resulted in considerable dilution of the plants given that the final volume of the experimental compost represented approximately 180 cubic metres for each batch.

■ The temperature in the mounds was monitored continuously.

■ The experimental results were based on a series of observations and planting trials:

- the stalks were inspected each month (each week in July and August) in order to detect any regrowth on the surface of the mounds;
- a sample of the rhizomes and stalks was collected during the third-month mixing operation in order to assess their status (decomposition and/or drying);
- seeds in small bags were placed in the compost and then planted in a laboratory after two, five and eight months of composting. Their germination rates were compared to those of a control group of seeds;
- finally, all of the experimental compost containing the rhizomes and seeds was spread on public land in the town of Viviers-du-Lac for two months (September and October 2017) to check for any regrowth. Control zones were created in the spread compost to check that any propagules or seeds still alive could regrow. The control zones consisted of five plots where fresh rhizomes and seeds were planted.

## Results and costs

### ■ Impact of composting on the rhizomes

■ After eight and one-half months of composting, the mortality rate for rhizomes was 100%. This result was confirmed by a comparison with 55 control rhizomes that produced 80 sprouts after being planted in the compost and subjected to the same weather conditions (see the figure on the following page).

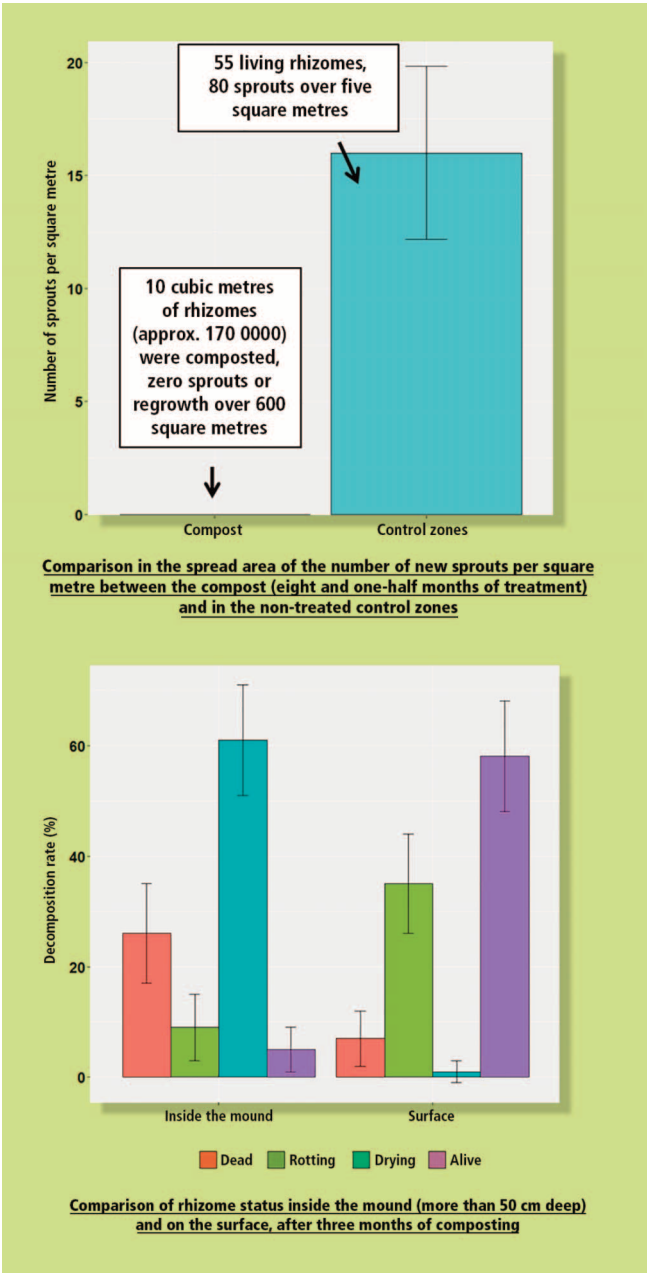
■ However, the experiment revealed major differences in processes and decomposition/drying speeds between the interior and the surface of the mound. Inside the mound, the rhizomes dried due to the effects of the high temperatures (≈ 70°C), whereas on the surface, certain rhizomes continued to sprout over a long period and others rotted in areas with high levels of humidity. These phenomena were observed for up to five months in the parts of the mound not mixed (see the figure on the following page).

■ On the Grand Chambéry site, the compost was mixed two times, which was sufficient to produce a homogenised mixture that resulted in the 100% mortality rate for the rhizomes.




*6. Incorporation of the knotweed seeds in the compost.*
*7. Mixing the stalks in fresh compost.*
*8. Integration of the experimental batch in the production cycle.*

*Impact of composting on the rhizomes.*




## Impact of composting on the seeds

No sprouts were observed in the compost spread after eight and one-half months of treatment (82 square metres were carefully inspected), whereas in the control zones, 41 sprouts were observed following the incorporation of 6 000 seeds (see the figure on the following page). It is clear that after the composting process as executed on the Grand Chambéry site, there is no risk that the final product contain any seeds capable of germinating.

However, seeds located on the surface of a mound, where the temperatures are lower, may remain capable of germinating for up to five months of the treatment (see the figure on the following page). Similar to the rhizomes, it is the mixing that homogenises the compost and buries the seeds, thus eliminating any risk of subsequent sprouting.

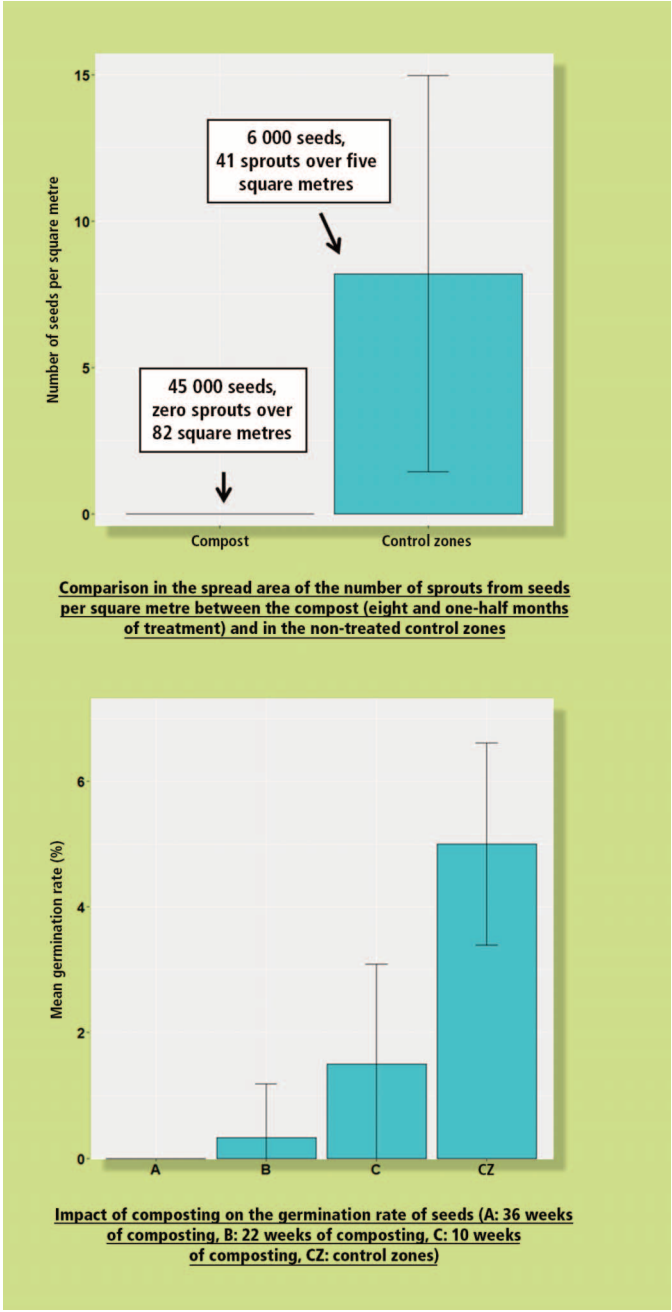
On the Grand Chambéry site, two mixing operations are sufficient over the eight and one-half months of treatment to eliminate any risk of subsequent regrowth of the knotweed seeds.





*9. Site where the experimental compost containing the rhizomes and seeds was spread.*
*10. Knotweed sprouts in the experimental compost after three months of treatment.*
*11. A sprout from a small fragment of rhizome on the surface of the experimental compost after five months.*
*12. Dead rhizomes after eight months of composting.*

*Impact of composting on the seeds.*




**Comparison in the spread area of the number of sprouts from seeds per square metre between the compost (eight and one-half months of treatment) and in the non-treated control zones**




**Impact of composting on the germination rate of seeds (A: 36 weeks of composting, B: 22 weeks of composting, C: 10 weeks of composting, CZ: control zones)**



*13. Seeds after eight and one-half months of composting on the left and control seeds on the right.*
*14. Knotweed sprout observed in a control zone and a green-yellow marker stick.*

## ■ Impact of composting on the stalks

■ Drying of the stalks proceeds much faster than that of the rhizomes. After three months of composting at temperatures of approximately 70°C, the seven cubic metres of stalks incorporated in the compost had fully dried.

■ A sprout on a stalk, observed after one month of treatment on the surface of the mound in an area that had remained relatively humid, did not survive more than one week. The stalks on the surface of the mound are capable of sprouting, however this is a rare and temporary phenomenon. No sprouts from stalks had survived after three months of treatment.

## ■ Costs

■ The experiment was funded (45%) by the Savoie department (10 457.50 euros before VAT) and for the remainder by Concept.Cours.d'EAU in the framework of its R&D programme.

## Recommendations

■ The experiment demonstrated that the composting technique, as implemented on the Grand Chambéry site, resulted in 100% mortality rates for the stalks, seeds and rhizomes of Asian knotweed.

■ Similar to any worksite handling invasive alien plants, there are a number of specific risks concerning the movements of the equipment and tools used for certain operations on the site. On the Grand Chambéry site, the site layout and the existing procedures considerably reduce those risks. Even greater control over the risks may be achieved by implementing additional measures during the chopping operations and the handling of the green waste.

■ The experiment further demonstrated that the minimum conditions imposed by the decree dated 22 April 2008, setting the rules for regulated composting units[1], are not sufficient to avoid any risk of dissemination. During the experiment, sprouts were observed following the first mixing operation, in spite of temperatures significantly higher than 55°C. Consequently, a composting cycle comprising only one mixing operation may allow some of the knotweed plants to survive.

■ These results suggest a number of more general recommendations for other installations. Composting units may accept the green waste produced by management work on Asian knotweed without any risk of disseminating the plants if all the following conditions are met:

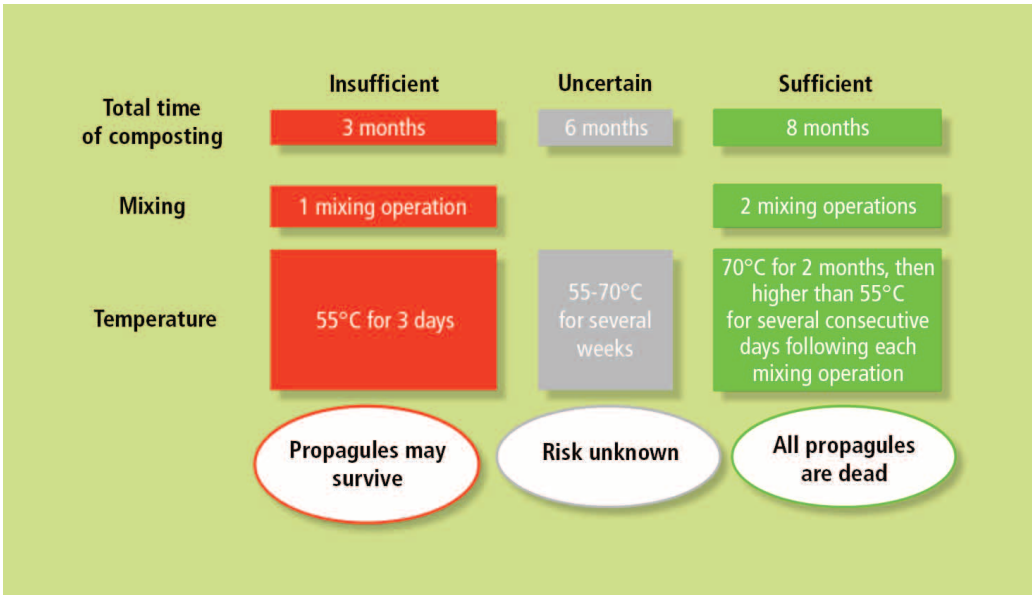
- the composting cycle must last eight months;
- the compost must be mechanically mixed two times;
- high and constant temperatures must be maintained in the mounds, approximately 70°C during the first month of treatment and then higher than 55°C for several consecutive days following each mixing operation;
- the dispersal risks of propagules and seeds by the equipment and tools must be systematically assessed and suitable preventive measures must be implemented.

■ For industrial composting units operating with much shorter production cycles and/or lower temperatures, the risk of dissemination remains. Additional study, specific to each site and addressing the differences in composting techniques, is required to eliminate the risk of dissemination.



*15. Sprouts on a stalk after one month of composting.*
*16. Dry stalks after three months of composting.*

*Assessment of the survival potential of plant propagules under different composting conditions.*




*1. Two weeks of forced ventilation resulting in temperatures exceeding 55°C for three consecutive days, plus one mixing operation after which the temperature must exceed 50°C for 24 hours.*

## Information on the project

■ The results of the experiment have already been presented to various services of the Savoie Departmental Council (roads, environment). The current objective is to disseminate this information more widely to people in the biodiversity field and in waste management (local governments, the region).

## Outlook

■ The experiment improved the available knowledge on the survival conditions of Asian knotweed propagules during industrial composting. Asian knotweed may be accepted without any risk of subsequent dissemination if the conditions and techniques used on the Grand Chambéry site are implemented. The results are also useful in better assessing the dissemination risks for the plant following composting in other types of composting units using other techniques. However, an in-depth assessment of the risks is required for each type of composting process.

■ Further study on the capability of rhizome fragments to resist drying would be most helpful in order to propose the conditions required to devitalise rhizomes in a number of existing composting processes and assist in developing several new techniques to devitalise the plant *in situ*.

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### For more information...

■ Barthod L. & Boyer M., 2017. Prévention du risque de dissémination des plantes invasives via la filière de valorisation des déchets verts par compostage – Étude de la survie des tiges, des rhizomes et des graines de renouées asiatiques intégrées dans un compost industriel. Concept Cours d'EAU. 52 pp.
■ Internet site of Concept.Cours.d'EAU SCOP Aquabio: www.cceau.fr