



Japanese hop

(Humulus japonicus)

Experiments in managing Japanese hop in the Gardons basin

Board for balanced management of the Gardons basin (SMAGE des Gardons)

- The SMAGE is a public river-basin territorial agency (EPTB) created in 1995 that represents 122 towns in the Gardons river basin (2 000 square kilometres on the right bank of the Rhône River) and the departmental council of the Gard department.
- It is the project manager for the SBMP (sub-basin management plan) and for the Gardons river contract. It has set up consistent, basin-wide policies for:
 - flood prevention;
 - management of water resources;
 - preservation and restoration of aquatic environments.
- Since 2009, management of invasive plant species has become an important part of the policy for natural environments.
- A multi-year management programme was established in 2012.
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Agency for food, environmental and occupational health & safety (ANSES)

- ANSES is a public agency placed under the supervision of the Health, Agriculture, Ecology, Work and Consumption ministries.
- The lab for plant health is active in monitoring, alerting and conducting collective science-advice projects in order to assess the risks caused by pests for the health of crops and forests.
- It also does work to determine the risks raised by new plants that are introduced and may become invasive.
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Intervention site

- The Gardon River flows through the heart of the Languedoc-Roussillon region. The river and its tributaries originate in the Cévennes mountains, in the Lozère department. They flow through the Gard department and into the Rhône River.



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1. Sites where Japanese hop has been observed in the areas managed by the SMAGE. <http://invasives.les-gardons.com>

- The Gardons basin comprises many remarkable aquatic environments (Cévennes national park, Galeizon biosphere reserve, Natura 2000 sites, the Gardon gorges) that are home to an array of emblematic species such as the otter, the European beaver, Bonelli's eagle, shad, eels, bug orchids and summer lady's-tresses.
- In 2004, 500 square metres of Japanese Hop were discovered by the National botanical conservatory (Mediterranean region) along the banks of the Gardon River, in the town of Saint-Anastasia (Gard department). The plants were the only known instance of the species in the natural environment in continental France.
- The European and Mediterranean Plant-Protection Organisation (EPPO) placed the species on its alert list in 2007 and, following a rapid assessment by the ranking protocol, Japanese hop was listed as an invasive species in 2012.
- A large number of invasive species have been observed in the rivers of the basin (water primrose, parrot-feather watermilfoil, water cabbage, alien knotweeds, summer lilac, amorpha, etc.). Given the size of the area (2 000 kilometres of river including 500 km of large rivers), a multi-year (2012-2017) management plan was set up in 2011. It is funded by the Water agency, the departmental board, the Gard departmental council and the EU (in 2012).



Disturbances and issues involved

■ Impacts on the ecosystem

■ The species forms dense, single-species stands that completely cover up to several hundred square metres of ground. It competes with and locally eliminates certain other species.

■ Impacts on health

■ The pollen has very high allergenic potential, comparable to that of common ragweed.

■ Economic impacts

■ Given that Japanese hop is sensitive to hydric stress, the risks of competition with crops in the Mediterranean environment were deemed very low. This assessment must be reviewed in more humid environments.

Summary of the studies carried out by ANSES

■ The multi-year management plan for invasive plant species in the Gardons includes a project to improve knowledge on Japanese hop in order to better understand its biology, impacts and the management possibilities. It was in the framework of this project that ANSES was commissioned to do two studies.

■ Study on the ecological plasticity of Japanese hop (2012-2013)

■ The objectives were to:

- identify the ecological position of Japanese hop with respect to other plants;
- quantify the impacts of hydric stress on the species;
- analyse its allergenic potential as well as the viability, production and dispersal of seeds.

■ Results:

- in the Mediterranean region, Japanese hop has a narrow ecological niche limited to bare river banks and to low areas that remain flooded until the beginning of spring. It has greater difficulty in places where plants are numerous (grassy beds of creeping bentgrass) and in areas where the riparian vegetation reduces the available light;
- moderate tolerance to hydric stress. Through morphological changes (reduction in size), the plant is not eliminated from the environment, but loses in competitiveness;
- the seeds have a very high germination rate (95% after one week of stratification (4°C) and one week in moist sand);
- the number of seeds released annually by a plant is thought to be greater than 1 000 and their longevity estimated at up to three years. Long-distance dispersal is due to flooding in the fall, short-distance dispersal to animals (parts of the inflorescence containing seeds attach to fur).

■ Study on the opportunistic nature of Japanese hop (2013-2014)

■ The objective was to compare the activity of Japanese hop with a native species of creeper present on the same sites (*Gallium aparine*).



■ Results:

- both species respond positively to an increase in available water (size and biomass), but only the hop takes advantage of a greater nitrogen input (more biomass). In relatively infertile areas, the two species produce similar quantities of biomass, which may indicate that Japanese hop is not capable of excluding certain native plants that are better suited to the local conditions. On the other hand, Japanese hop is far more productive in resource-rich environments such as river banks (height of the plant, biomass, leaf traits);
- the competitive impact of Japanese hop is high due to the fact that it rapidly covers the ground and hinders germination of many other annual plants on river banks. The drop in plant diversity reaches 55% during the growing season (May) and 100% by the end of the season (September).

Interventions

■ Inventories

- Inventories were conducted from 2012 to 2014. In order to optimise costs and the informative value of the research, the Japanese hop was included in a list of other invasive species covered by the management plan:
 - the three Asian knotweed taxa, namely Japanese knotweed (*Reynoutria japonica*), giant knotweed (*Reynoutria sachalinensis*), Bohemian knotweed (*Reynoutria X bohemica*);
 - summer lilac (*Buddleja davidii*);
 - desert false indigo (*Amorpha fruticosa*);
 - parrot-feather watermilfoil (*Myriophyllum aquaticum*);
 - water primrose (*Ludwigia* spp.).
- Almost 150 kilometres of river were inventoried.
- Again in order to reduce costs and given the low tolerance of Japanese hop to shade, only the river bed, bare gravel bars and the first ten metres of riparian zones were studied by the firms doing the work. The studies took place primarily during the summer in order to give the plants time to develop, thus facilitating their detection.
- All sites where the plants were found were identified with GPS data.



2. Herbaceous area colonised by Japanese hop.
3. A patch of nettles colonised by Japanese hop, being uprooted.
4. A mat of creeping plants colonised by Japanese hop.



Map of the intervention sites.

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■ Tests on different management methods

Tests on management methods were conducted in two sectors (see the previous page):

- sector 1. The entire upstream invasion front was uprooted over a distance of two kilometres (Vézéobre-Ners), where the plant had colonised small surface areas, in order to study its recolonisation potential following uprooting, in an area where no seeds arrived from upstream;
- sector 2. Heavily colonised areas, located in the downstream section of the river basin, are uprooted using a number of different techniques. The point here was to determine the time required for each technique.

Three techniques were tested on three different environments (low herbaceous plants, an area colonised by giant cane (*Arundo donax*), a reed bed and mat of creeping plants).



6. A shredder blade and the results in the field.
7. A cutter blade and the results in the field.

■ Manual uprooting

Type of environment	Low herbaceous plants	Nettles	Giant cane	Reed beds
<ul style="list-style-type: none"> ■ Method employed 	<ul style="list-style-type: none"> ■ Manual uprooting. ■ Clear the foot of the bank to create a collection zone, then push the plants down from the top of the bank. ■ Sort the roots to preserve the native species. ■ Remove only the main Japanese hop roots. 	<ul style="list-style-type: none"> ■ Manual uprooting. ■ Cut the roots of Japanese hop (the plants are easily identifiable among the nettles). ■ Deposit the plants in a clearly identified area, free of Japanese hop. 	<ul style="list-style-type: none"> ■ Manual uprooting. ■ Cut the roots of Japanese hop (the plants are easily identifiable among the nettles). ■ Deposit the plants in a clearly identified area, free of Japanese hop. 	<ul style="list-style-type: none"> ■ Manual uprooting. ■ The Japanese hop plants were identified at ground level (the reeds made identification difficult). ■ Care was required in removing the hop (the reeds break easily).

■ Mechanical cutting:

- mechanical cutting was done in an area where the Japanese hop had colonised a mat of creeping plants;
- one part of the site (200 square metres) was cleared using a brush cutter equipped with a shredder blade;
- the second part (250 square metres) was cleared using a brush cutter equipped with a coppice-cutter blade at approximately 15 centimetres above ground level.

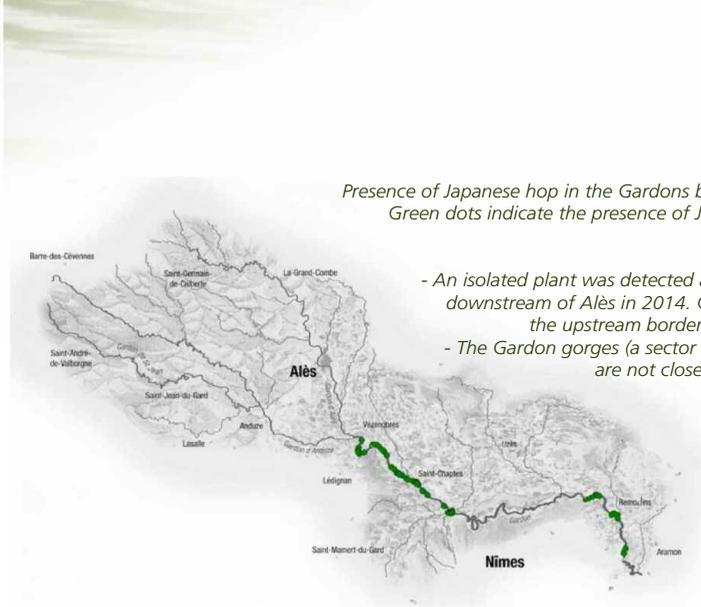
Results and assessment

■ Results

■ Inventory data:

- the results confirmed the significant expansion of Japanese hop since 2004;
- the plant is widely present along 80 kilometres of the main river (the Gardon River);
- the plant is expanding naturally in the downstream section of the basin and is probably already present along the Rhône downstream of the confluence with the Gardon





Répartition du Houblon du Japon sur le bassin versant des Gardons en 2013.

■ Results of the tests on management methods

The type of vegetation growing in conjunction with Japanese hop would not seem to have an impact on the time spent in managing the hop, with the exception of environments colonised by giant cane where manual uprooting is necessary (due to the hardness of the stalks) and environments with reed beds or typha (fragile plants).

■ The effectiveness of manual uprooting could not be assessed due to the strong floods in the fall of 2014 that significantly modified the area.

■ Mechanical techniques

The areas cut mechanically were analysed with ANSES in October 2014:

- in the area treated with a shredder blade, the number of new sprouts was negligible and there were no flowers;
- in the area treated with the cutter blade, the hop plants were still present everywhere (though the density was lower than in non-treated areas) and seeds were observed. This technique did not reduce the risks of pollen being released or of seeds being dispersed.

As a result, simple cutting is not a suitable management technique.

■ Financial aspects

■ The costs of the three management techniques for Japanese hop tested in 2014 were calculated.

■ On the basis of the calculations, an average cost of 6 euros per square metre was set to estimate the cost of future work over the entire colonised area in the Gardons basin. This cost takes into account the different techniques employed (mechanical techniques are not possible in certain sensitive natural environments or in those difficult to access) and the inevitable drops in productivity when dealing with repetitive operations over almost 80 kilometres of river.

Management technique	Sq. metre / person / hour	Hourly cost (not incl. VAT)*	Cost per sq. metre (not incl. VAT)
Manual uprooting 33 hours x 3 people = 340 sq. metres	3.4	35.7	10.4
Cutting (with cutter blade) 1.6 hours x 3 people = 250 sq. metres	55.6	35.7	0.6
Cutting (with shredder blade) 1.5 hours x 3 people = 150 sq. metres	33.3	35.7	1.1

* The hourly cost was estimated on the basis of a 250 euro work day (not including VAT).



8. Result of manual uprooting on a bank (herbaceous area).

9. Result of shredding immediately after the work.

- It is necessary to add the time required to travel the river and find the Japanese hop. It was estimated that a team of two could examine three kilometres per day, for a cost of 167 euros per kilometre of river.
- The calculations included the management work on 80 colonised kilometres of the Gardon River, between Ners and Comps, and an in-depth search for Japanese hop on the tributaries over a period of two years.
- It should be noted that Japanese hop is an annual species and isolated sites are therefore found. Due to increases in competition or modifications in the environment, the work on these sites is not necessarily repeated from one year to the next. Work is shifted to sites where seeds have sprouted. For this reason, the isolated sites receiving work vary from one year to the next, whereas on larger sites (several hundred square metres), the work is much more regular.

Surface areas (m ²) inventoried in 2012 and 2013	Surface areas (m ²) estimated in 2015	Cost of work year N* (euros before VAT)	Cost of work year N+1 (euros before VAT)	Management costs (euros before VAT)	Miscellaneous (euros before VAT)**	2-year budget (euros before VAT)	VAT	2-year budget (euros incl. VAT)
19 949	29 924	191 378	57 413	57 413	44 017	484 187	96 837	581 024

* The hourly cost was estimated on the basis of a 250 euro work day (not including VAT).

** Miscellaneous includes legal announcements, coordination, work safety, monitoring and communication.

Information on the project

- Information was provided to neighbouring river boards via a note and a species fact sheet.
- All technical and financial partners in the management plan received information on the study conducted over two years and on the decision not to manage Japanese hop unless a collective decision is taken.
- A report on the studies and management experiments was sent to the various organisations in a position to decide on launching a major management project against this emergent invasive species.
- A special internet page is available on the SMAGE site:
<http://invasives.les-gardons.com/wikini/wakka.php?wiki=HumulusJaponicus>

Outlook

- It was decided to halt the work on the species given its range exceeding the SMAGE territory and the management costs exceeding the available budget.
- The management work on the species may be resumed if there is a decision to launch a regional or national effort involving all the concerned managers.
- The studies on the plant's ecology (soil analyses, analysis of the grain bank this year) and on its impact (the second year on the same sites to observe any variability) will be finished and published by ANSES.

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This management report was drafted in May 2015 by the work group for biological invasions in aquatic environments, set up by Onema and IUCN France, in addition to those already presented in the second volume of the book titled "Invasive alien species in aquatic environments, Practical knowledge and management insights", in the Knowledge for action series published by Onema.

<http://www.onema.fr/sites/default/files/ENIEV/cat7a-thematic-issues.html>

For more information

- The SMAGE internet page on the species may be consulted at: <http://invasives.les-gardons.com/wikini/wakka.php?wiki=HumulusJaponicus>
- Pinston A. 2013. Etude de la plasticité écologique d'une plante invasive, *Humulus japonicus*. Mémoire de stage de master 1, Université de Bourgogne, 35 pp.
- Mahaut L. 2014. Le Houblon du Japon (*Humulus japonicus*), une espèce locomotrice ou une simple passagère du train des changements ? Mémoire de stage de master 2, Université de Montpellier 2, 44 pp.
- Smage des Gardons / Entreprises DEHAÏOT- DIAZ. 2014. Test de 3 méthodes de traitement d'*Humulus japonicus* : arrachage manuel, fauchage, broyage. 11 pp.
- Smage des Gardons. 2014. Bilan de deux années d'études sur le Houblon japonais (*Humulus japonicus*). Appel à décision sur l'opportunité d'une gestion. 9 pp.

