



Department
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Llywodraeth Cymru
Welsh Government



Progress with Weed Biocontrol Projects

CABI - UK

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Cover image: D. Djeddour releasing *Listronotus elongatus* adults in the first field trial, river Colne

Introduction

Since April 2011, Defra in partnership with the Welsh Government and Natural England has been funding specialist scientists to investigate the scope for biological control (biocontrol) of invasive, non-native aquatic and riverside weeds. Additional financial support for this research has been provided by the Environment Agency, the Canal & River Trust, private water companies, the MoD, and a number of Wildlife Trusts and Local Authorities (* see also footnote for additional funders). Biocontrol has the potential to play an important role in protecting aquatic and riparian habitats where chemical and mechanical control options are impractical or prove to be prohibitively expensive. This will help to meet statutory and policy commitments, both at a UK government level and within the Devolved Administrations (DAs). This control method is already providing sustained and highly successful management of the invasive exotic water fern *Azolla filiculoides* through *Stenopelmus rufinasus*, a weevil native to the Americas which was introduced into the UK together with the weed.

CABI is targeting **Australian swamp stonecrop** (*Crassula helmsii*), **Himalayan balsam** (*Impatiens glandulifera*), **floating pennywort** (*Hydrocotyle ranunculoides*) and parrot's feather (*Myriophyllum aquaticum*), and these projects complement our on-going work on the biocontrol of **Japanese knotweed** (*Fallopia japonica*). CABI is also mass-rearing and supplying the **water fern weevil**, for early season inoculation of infestations of the weed, to ensure ongoing biocontrol. The sale of any of these species in the UK is an offence due to their highly invasive nature. This is the 14th in a series of annual summary notes on progress made and covers the time frame from December 2021 to the end of April 2022. <http://www.invasive-species.org/united-kingdom/>

Japanese knotweed (*Fallopia japonica*)



Releases of the Kyushu line of the psyllid *Aphalara itadori* (from 2010 onwards) demonstrated safety, and reproduction was observed on *F. japonica* at several release sites, with some overwintering recorded; however, long-term establishment and persistent overwintering have proved elusive. To tackle these issues, better climatically-matched psyllid cultures, which were observed to cause extensive and severe leaf-curling damage in Japan, were collected from Murakami, further north in Japan. Host-specificity testing showed that the Murakami line is also a specialist on Japanese knotweeds. After Defra approval for release was obtained in 2021, the line was released at one *F. japonica* and *F. x bohemica* site, respectively, during the summer. Field monitoring showed curling damage on plants at both of these sites during the season, being particularly heavy at the *F. x bohemica* site where overwintered adults were found this spring. Studies of the leaf-curling on *F. x bohemica* highlight its role in promoting psyllid survival. The Murakami psyllid was also released in the Netherlands and Canada in 2021, and field results are now being shared between all countries. The Kyushu psyllid line was released at *F. japonica* sites in north-east England for the Tees Rivers Trust in 2021 and overwintering assessment and a further release will take place in the coming weeks.

The leaf-spot fungus *Mycosphaerella polygoni-cuspidati* is under evaluation for use as a mycoherbicide as studies showed that the pathogen can cause restricted disease symptoms on selected non-target plant species under quarantine conditions and is thus not suitable for classical biocontrol. Basing a potential mycoherbicide on a single-mating type isolate would prevent reproduction, persistence and spread of the fungus in the field and allow for targeted applications. A European patent held in the name of the Secretary of State protects the idea with registration in twelve individual countries; further international patent applications are pending. Following Defra approval for release from quarantine, CRD-licensed experimental field trials have been conducted with the agent at CABI, Egham from 2019 to 2021. Collated trial data show that the agent can infect Japanese knotweed and, to a lesser extent Bohemian knotweed, under more natural conditions. Higher ambient temperature and lower relative humidity have an adverse effect on disease development. Results also indicate that early season application of the agent leads to better disease development due to higher susceptibility of the plants. Experimental work has established methods to retain agent virulence *in vitro* prerequisite to achieve good performance of the agent in the field. Re-newed collaboration with private industry is currently being explored and it is hoped that ultimately a product can be developed to control Japanese knotweed which would be applied in much the same way as a herbicide but without side effects.

Floating pennywort (*Hydrocotyle ranunculoides*)



The weevil *Listronotus elongatus* was approved for release into the wild in the UK in autumn 2021 after a decade of safety and efficacy testing. This provided an opportunity to undertake preliminary field trials during the winter months at 2 sites in England. In addition, a semi-controlled experiment conducted in a polytunnel facility allowed more detailed assessments of adult and immature stage survival, development and behaviour under local environmental conditions, from November through to May. Results have been very encouraging and suggest that adult weevils persist well, that their feeding and egg-laying activity increases with the onset of spring and that immature stages have a significant impact on plant biomass even at lower temperatures. Mass rearing of weevil cultures is now the focus, with a top up shipment from collaborators in Argentina anticipated to further maximise release potential. Funding has been secured to facilitate releases at several selected sites in England from mid-summer and a bespoke monitoring

app has been developed to facilitate and streamline data collection and analysis both in the field and in the lab in follow up assessments. The molecular characterisation of pennywort from 22 representative regions in England indicates a high level of genetic similarity, with populations falling into 2, possibly 3 distinct but closely related groups. National and international stakeholder engagement has been key to fund raising to support weevil and plant stock maintenance, identification of appropriate sites and securing land owner permissions for proposed releases. Proactive communications and sustained collaborations with a wide range of partners and stakeholders continue to underpin the project progress. These field releases herald an exciting stage in the project and it is hoped that the biocontrol agent will contribute to the national strategic approach to floating pennywort management, providing a long-term and sustainable solution.

Himalayan balsam (*Impatiens glandulifera*)



A strain of the Himalayan balsam rust fungus *Puccinia komarovii* var. *glanduliferae* from India, was approved for release into the wild in the the UK in July 2014. However, due to the presence of some rust-resistant populations, an additional rust strain from Pakistan, which was found to infect a different subset of Himalayan balsam populations, was approved for release in 2017. The rust has been released widely in England and Wales and since 2020, has been released in Scotland. Pre-release susceptibility testing, to ensure the most virulent and pathogenic strain is released at each site, and an updated release strategy involving working with Local Action Groups across the country, has significantly increased infection levels in the field. Although early days, the results are encouraging; the rust has established at numerous sites, successfully overwintered with the development of good levels of leaf infection during the following growing season and spread naturally more than 100 metres. The rust continues to be released at compatible sites, however, in order to counter the presence of resistant populations and achieve full control, additional rust strains are required. Key regions in the native range harbouring strains more likely to be fully compatible with UK populations were identified through molecular analysis. Collaborators in Pakistan surveyed these key areas for new rust strains in 2021 and exported rust-infected plant material to CABI in the autumn. Unsusceptible Himalayan balsam populations will now be tested against the new rust strain in CABI's quarantine laboratories.

Water fern (*Azolla filiculoides*)



Azolla survived the winter well into 2021 and demand for the Azolla weevil, *Stenopelmus rufinasus*, which is mass reared at CABI was high all season with shipments continuous over the summer. Pre-orders for 2022 suggest another busy year. *Stenopelmus rufinasus* feeds specifically on Azolla and in high densities can cause local eradication of the weed. In addition, Azolla infestations are frequently brought under effective control by naturalised populations of the weevil, particularly in regions that have recently received significant weevil introductions, demonstrating the valuable underlying control exerted by this effective agent. By targeting Azolla outbreaks in a timely manner, it is possible to limit impacts and preserve the biodiversity of freshwater ecosystems. www.azollacontrol.com

Australian swamp stonecrop (*Crassula helmsii*)



The gall-forming mite, *Aculus crassulae* (Eriophyidae) was approved as a biocontrol agent against *Crassula helmsii* in August 2018 following the acceptance of the PRA detailing the research conducted to date on the mite. Field trials with the mite were initiated in September 2018 with the inclusion of additional sponsors from the water industry. Mites were released at two new sites in 2021 bringing the total number of release sites across England and Wales to 12. At the release sites, mites have been observed infesting plants within and close to release plots, and the number of mite-infested plants has generally increased over the course of the summer. Overwintering studies at CABI have also provided evidence that *A. crassulae* can survive and develop sustainable populations under UK environmental conditions. Efforts are now needed to increase the population density of mites at release sites to enable establishment and subsequently, impact. During winter 2021/22, additional sites were assessed for their suitability as potential release sites in England and Wales. During these surveys, mites were observed at several of the previous release sites.

Parrot's feather (*Myriophyllum aquaticum*)



Following an initial feasibility study to assess its potential for biocontrol in 2021, parrot's feather has now been included as a new target for biocontrol in the UK. A leaf-feeding beetle, *Lysathia* sp., which has previously been released in South Africa and provides good control of parrot's feather there, was imported from South Africa in September 2021. Safety testing and life-cycle studies with this beetle are currently underway in CABI's quarantine laboratories. Molecular studies are also taking place to understand the genetic diversity of parrot's feather in the UK. Collaboration has been established with the Fundación para el Estudio de Especies Invasivas (FuEDEI) in Argentina, where parrot's feather originates. Scientists at FuEDEI are also investigating the stem-mining weevil *Listronotus marginicollis* which has potential as a biological control agent against parrot's feather.

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*Footnote: Prior to 2011, funding for this research has also been provided by the Scottish Government, predecessor bodies of the Welsh Government, Network Rail, Cornwall Council, the Regional Development Agency of South West England