

The CABI Podcast: Toadflaxes

Audio Transcript



Joanna

Native to Europe, Yellow toadflax and Dalmatian toadflax can typically be found on roadsides, grasslands and in crop fields. Like many other weeds, toadflaxes have been introduced to North America as decorative plants but they are now having adverse effects...

Joanna

Welcome to the CABI podcast. In this series we're focusing on invasive species.

I'm Joanna.

On this episode of the CABI podcast we're hearing all about the invasive weeds, Yellow toadflax and Dalmatian toadflax, with expert guests Hariet Hinz and Ivo Tosevski from CABI in Switzerland...

Hariet

My name is Hariet Hinz. I've worked at CABI for 27 years. I started as a summer student and did my PhD here in the section of weed biological control. Since 2006 I am leading the weed section here at the centre and four years ago, I then became centre director, but I'm still responsible for the weed section. We currently have 16 different projects, mostly for North America, and toadflax is one of them.

Ivo

My name is Ivo Toševski. I have more than 30 years' experience in biological weed control, insect taxonomy and applied research. Through my career, I have built up a broad background of rural development and integrated pest management of insects and it's my main research interest is weed control, molecular taxonomy and applied molecular biology study.

Joanna

So, what are toadflax and where are they native to?

Hariet

So, toadflax are perennial short-lived forbs with, actually, quite pretty yellow flowers. There is yellow toadflax and dalmatian toadflax, and they differ in their leaf shape. So, yellow toadflax has slightly thinner leaves and dalmatian toadflax broader leaves. They're both native to central temperate Europe but yellow toadflax can occur also in Asia, up to China.

Joanna

Invasives are typically introduced because of their attractive flowers but also as traditional remedies as Ivo explains...

Ivo

Both of these highly competitive and invasive plants were introduced to North America during 18th century as ornamentals or, like yellow toadflax, as traditional folk remedy for treatment of liver disease.

Joanna

Whilst these weeds may look pretty and provide decorative appeal, they soon escape cultivation and can cause some serious problems. In Canada and North America, the toadflaxes are causing particular concern to agriculture, biodiversity and wildlife and as a result have been listed as noxious in several US and Canadian states.

Hariet

Yellow toadflax is – or they're both, actually, weeds in pastures. They are avoided by cattle; the cattle won't eat these plants and that obviously reduces the pasture value because then it replaces more plants that are preferred by cattle.

They can also invade perennial forage crops, reducing yield. Yellow toadflax can also invade annual crops, reducing yields in canola and wheat. And they can become especially problematic now with the reduced tillage system in order to avoid erosion. So, they can really establish in these reduced tillage systems. They can also invade relatively undisturbed areas thereby reducing native biodiversity, which then negatively impacts wildlife.

Ivo

Yellow and Dalmatian toadflax are perennial plants capable to reproducing the seeds and rhizomes and because they start growing early in spring, both species are highly competitive for space and light, thus gradually suppressing growth of native plant species.

Joanna

And the rate at which the toadflaxes can spread is pretty impressive...

Ivo

The reproductive capacity of yellow toadflax is great. A single plant produces over 100 shoots during the vegetation, from rhizomes forming dense carpet of yellow toadflax. Each stem can produce up to 30 seed capsules, with each capsule yielding up to 250 seeds. Thus, one stem can produce over 7500 seeds per stem or over 20,000 seeds per single plant. The seeds are spread by wind, which facilitate dispersal and cause invasion of yellow toadflax.

Similar to yellow toadflax, the Dalmatian toadflax also possess great spreading capacity. One plant is able to produce up to 25 stiff erected leaf stems. Each seed capsule contains up to 300 triangular slightly wrinkled small seeds thus mature plant can produce more than half million seeds.

Joanna

So, with their prolific ability to reproduce and spread, controlling the invasive weeds is difficult. There are a number of ways to help control the spread but not all are effective or economical as Harriet explains...

Harriet

So, there are obviously cultural methods. There is also chemicals you can spray but since it's there for quite a long time, it has developed resistance against a lot of the more common and inexpensive herbicides. And obviously these methods need to be repeated every year, so it's very time, labor intensive, high input and especially on these more extensive pastures, that exist in North America, it's sometimes not economical.

Joanna

Biocontrol or biological control is another option for control and has been used for over 100 years to effectively manage invasive weeds using living organisms such as insects or pathogens. The aim of biocontrol is not to eradicate the invasive species, but control it in a way that it becomes manageable.

Harriet

Classical weed biocontrol tries to introduce host-specific herbivores, so that could be insects, mites or fungal pathogens from the native range of the invasive species. So, the idea is not to eradicate these invasive plants but to reduce the vigor, reduce their spread, to give the native plants a chance to compete against them.

And, the so-called biocontrol agents we introduce are expected to establish and spread themselves, so they are self-perpetuating. Obviously, they need a little bit of help with that. But, if it works, it can be an extremely cost-effective method.

Joanna

Biological control can be a long process and can take years from initiation to the release of an agent, as Harriet explains...

Harriet

You're working with living organisms. It's not like a pesticide that you apply and if you know in advance it will reduce your target weed by 80%. It doesn't work like that. First of all, the insects, these biocontrol agents, need to establish, and it's known that only about 63% of them do establish.

The reason is that they need to adapt to new climatic conditions. In a lot of parts in North America the climate is very harsh, maybe the winters are longer, so the insects also need some time to adapt to these new climatic conditions, and that can take several years, sometimes even 10 years, sometimes 20 years in a, you know, worst case scenario. But sometimes it's also very fast. It really depends on how quickly the insects adapt to these new conditions.

Joanna

Another positive to biological control is that it is a much safer alternative to chemical control both for humans and for the environment. And, it is sustainable.

Hariet

Most of our work consists of host-specificity tests, so meaning to establish the host range of these insects, make sure they only develop and thrive on the target weeds, not on any native species that are closely related or any crops or other economically important species. So that is obviously one of the main emphases that we really try to make sure that these insects that are released are environmentally safe.

Joanna

CABI has over 60 years of experience in biological control and is using our expertise in this area to help fight the Yellow and dalmatian toadflax in North America.

Ivo

Control of invasive toadflax species in North America was first initiated in the early 1960s, by using classical biological control approach. Biological control is a component of integrated pest management strategy, where natural enemies of the target pest from the country of origin are using to reduce pest populations.

Together with partners from USDA and Agri Food Canada, CABI scientists were involved from the beginning in the biological study of toadflaxes into a native origin in Europe, and in selection of potential biological control agents.

Joanna

As Ivo said, biological control for toadflax started in the 60s. Only through studies and tests can potential agents be identified.

Hariet

So, already in the 60s, or from the 60s onwards, seven of these so-called biocontrol agents were released against both yellow and dalmatian toadflax, and especially one weevil, *Mecinus janthiniformis*, as it's called at the moment, was or has been very successful against dalmatian toadflax.

At the time when this insect was released, genetic methods were not quite as developed as nowadays, and it's only in retrospect that we realised that it's one particular weevil that was released in the 80s, 90s, was actually two different species; one specialised on dalmatian toadflax and the other one specialised in yellow toadflax.

Ivo

During the permit study associated with the control of herbivores in Europe, it was evident that weevils belonging to the family Curculionidae or snout beetles from the

two genera *Mecinus* and *Rhinusa* are highly specific for feeding and complete development of toadflaxes.

Joanna

Following the research and studies, the weevil, which specializes on yellow toadflax, was released in Alberta and British Columbia, Canada in 2014. In 2018, its release was also approved in the USA, and first field releases happened in 2019 in Montana. But one of the crucial questions is, how do we know if these agents are going to work?

Hariet

So, it will definitely need to be reared, mass-reared and re-released and monitoring will need to continue to really see whether it does establish.

In Canada, the insect established at all release sites, but it hasn't taken off yet. I mean, it hasn't reached densities yet, outbreak densities yet, that you need in order to successfully control these target weeds that you have to imagine they're on thousands of hectares, they form monocultures. So, you need a lot of these insects in order to successfully control them. So, this is something that can take a while, it needs a lot of persistence, you know, re-releases.

Joanna

What do the weevils look like and what are the effects of these agents on the toadflax?

Hariet

So, the *Rhinusa pilosa*, so it's a weevil and weevils are a form of beetle with a snout, with a rostrum, so it looks a little bit like a small elephant. They're really cute if you can look at them under the microscope, you would find them really cute.

So, the insect, what the insect does, the females lay eggs in early spring into the shoot tips of the plant, and the shoot then develops into a gall. And this gall attracts a lot of the resources from the plant, with the effect that it stunts the plants considerably, and also reduce – considerably reduces the seed production. So, if the insects occur at high densities, I'm sure it will have – it will considerably reduce the vigor of these plants.

Joanna

Biological control is not a quick fix – there's a lot of science behind releases as you have heard in this podcast. Ivo and scientists at CABI in Switzerland are now researching agents that attack the hybrid between yellow and dalmatian toadflax.

Hariet

Ivo is currently looking into this *Mecinus heydeni*. The big advantage of that one is that it also attacks the hybrid between yellow and dalmatian toadflax. Because you can imagine, once you successfully control dalmatian, you successfully control yellow, then the hybrid might thrive. So, you also need to already anticipate to look at a solution for the hybrid.

Joanna

To find out more about the hybrid research, CABI's work on the yellow and dalmatian toadflax and its results, you can search for toadflax or biological control on the CABI website.

From the general public's perspective, hearing that thousands of insects are going to be released, or have been, might cause some people to be concerned. However, they need not



be and through education and awareness campaigns, the general public can be reassured that biocontrol is a good thing! Harriet relieves some of these worries.

Harriet

I think it really depends whom you're talking with. I think it's – if it's a farmer, and he has a toadflax problem and he sees that these insects occur in their thousands and reduces weeds, he will be very happy, you know. There have been rare occurrences where after this mass outbreak of insects that, you know, there are just thousands of hungry insects that might then start dispersing, maybe nibbling on something else, but then after a few days they die, you know, because they cannot survive on anything else.

And it has happened that then concerned homeowners might call the authorities and say, I have these insects, they're feeding on my salad, or whatever, you know, and they get concerned. Now, these are very temporal instances that don't last for a long time, but it can cause concern, that's clear. Overall, biocontrol has proven to be very environmentally safe.

Joanna

Thank you to our guests Harriet and Ivo from the CABI centre in Switzerland for today's podcast.

This podcast is a CABI production and was presented by Joanna Slezak and edited by Tom Swindley.

For more information about CABI and our wider work, please visit cabi.org

And we'll see you next time on another episode of the CABI podcast.