Rhinusa pilosa (Gyllenhall, 1838)

INVASIVE SPECIES ATTACKED: Yellow toadflax (*Linaria vulgaris* L.)

PREVIOUSLY KNOWN AS: *Gymnetron pilosum*

TYPE OF AGENT: Stem gall forming weevil

COLLECTABILITY: Not available for general distribution

ORIGIN: Belgrade, Serbia.

DESCRIPTION AND LIFE CYCLE

Adult:

Rhinusa pilosa bodies measure 3.2-4.3 mm long and are black, covered with a soft, dark grey pubescence and a dense layer of bristled black coloured hairs. Their rostrum is shorter than their prothorax and is slightly curved and rigid at the tip. The male's rostrum has rough punctures throughout, while the female's rostrum is nearly smooth. Their wing covers are twice as long as they are wide[2].

R. pilosa adults emerge from diapause in late winter or early spring between March and May which coincides with the plants' early burst of spring growth. The spring emerging adults are suspected to disperse within the infestation. After emergence, the adults feed for 3-5 days on the plants' spring shoots and leaves before they begin to mate. Females commence ovipositioning about 10 days later which generally occurs in April or May, but may also begin and/or end earlier or later depending on environmental conditions[2]. The female chews an "oviposition canal" on the plant stem and deposits an egg into the pith (spongy tissue) of an early spring shoot near the stem tip[1, 2]. After the egg is deposited, the female taps her antennae on the stem and removes her ovipositor. During the oviposition process, the female excretes a clear fluid that changes to blue within two hours. Generally 3-5 eggs are laid into a single yellow toadflax stem. In the lab, each female is capable of producing 56 surviving offspring. Galls develop as a result of eggs laid into the plant stem[2]. They become visible within 48 hours after the females oviposit into the stem[1]. The newly developed adults remain in the galls and feed for about 10-15 days before they chew exit holes through the wall of the galls and emerge[2]. It is believed this adult feeding within the galls is critical for adult survival during the winter diapause period[1]. The entire life cycle of egg through to adult takes 55-65 days and is done entirely within galls. After the new adults emerge they will feed on plant stems for another 10 days before they seek suitable locations in the soil to aestivate for the remaining summer. Occasionally during the aestivation period, adults will emerge for light feeding, often preferring to do so in the evenings or at night[2].

Fig. 1. *R. pilosa* gall formation on lower portion of yellow toadflax stem

Fig. 2. *R. pilosa* gall formation on upper portion of yellow toadflax stem

Egg:

The eggs are roundish shaped, greenish coloured, and measure 0.3 x 0.25 mm[2]. At 22°C the eggs will hatch in eight days[1].

Larva:

R. pilosa larvae complete development through three larval instars and feed on plant tissue inside the galls. After the eggs hatch, the new larvae begin to feed within the galls and will moult twice. The two moults occur every 7-8 days. The third instars pupate inside the galls. Galls generally contain multiple larvae, but it is not uncommon for a single larva to develop in a gall. In lab and field studies carried out in Serbia, the highest quantity of adults to emerge from a single gall was 17, though the average gall typically yields 2.4 adults[2]. In the lab at 22°C the galls complete

development 8-10 days after the females have oviposited into the plants' stems[1, 2]. The galls' surface is smooth and their colour can vary from light green to reddish-green. As the galls develop they create more lignin (woody tissue) and become firm[1]. Galls are typically globular, round or oblong and occur between the mid-point to the tip of a plant stem. The galls measure approximately 9 mm wide x 18 mm long. The larvae and pupae development phase generally takes 45-50 days to complete[2].

Pupa:
The pupation period takes 10 days to complete and occurs within the gall[1].

Overwintering stage:
Adults overwinter in the soil or plant litter within the infestation[2].

EFFECTIVENESS ON HOST PLANT

The gall formation caused by *R. pilosa* has been observed to severely stunt host plant shoots and prevent flowering. Agent attack is expected to reduce the plants' vigor and reduce its competitiveness and subsequently reduce seed production. When compared with other galling insects, there is also the expectation that *R. pilosa* may contribute to the plants' inability to transport moisture and nutrients to the foliage which can cause desiccation[2]. Gall formation may reduce plant biomass and divert resources away from the roots[1,2]. In B.C. it is not uncommon to find stems broken off above the galls.

Fig. 3. *R. pilosa* exit holes on previous year yellow toadflax stems

HABITAT AND DISTRIBUTION

Native:
Historical reports indicate *R. pilosa* may be widely distributed in central, eastern and south-eastern Europe, Russia, Holland, Denmark, southern Sweden, Algeria and Tunisia. However, many of these records have not differentiated the two species *R. pilosa* and *R. brondelii*[2].

R. pilosa specimens were examined from collections taken in Sweden, Denmark, western Russia, Ukraine, Belgium, France, Germany, Hungary, Croatia, Serbia and Romania. During the screening process scientists confirmed the native range of *R. pilosa* occurs from Sweden, southwest into France, and southeast into Serbia. *R.pilosa* is considered rare in western Europe. The *Rhinusa* species occurring in southern France, Spain, Portugal, Italy and northern Africa is suspected to belong to a different taxa[2].

North America:
R. pilosa first arrived in North America in 2013 for lab rearing and pest screening via Serbian populations. These first shipments were received by Agriculture and Agri-Food Canada (AAFC), Lethbridge, Alta., Canada and Montana State University, Bozeman, Mont., U.S.A. In Canada, the first *R. pilosa* populations released into the field occurred in 2014 in the eastern and central geographical areas of B.C. As of 2016, it does not appear the U.S.A. has made any *R. pilosa* field releases[3].

British Columbia:
Releases have been made in the Interior cedar hemlock, Montane spruce, Ponderosa pine and Sub-boreal spruce biogeoclimatic zones. All had same year establishment, however, no galls were found the following summer at the two releases made in the Interior cedar hemlock zone. The established sites occur at elevations between 694 m and 1300 m.

BRITISH COLUMBIA RECORD

Origin:
The weevils released in B.C. originate from populations first obtained from northern and eastern Serbia from an area known as Zemun (Belgrade) and reared in the quarantine lab at the Lethbridge, Alta., AAFC facility[2].

History:
The first 511 *R. pilosa* adults shipped to B.C. in 2014 were released into three field sites near Elkford (150 weevils), Cranbrook (196) and Prince George (McLeod Lake) (165). The second shipment of 516 adults were released the following year near Golden (Donald) (220) and Kitwanga (296). The adults released near Kitwanga were divided into two field releases; 200 adults were released on a vacant lot while 96 adults were released in a cemetery. In 2016, an operational trial was initiated in Quesnel with 223 adults and later supplemented in 2017 with an additional 100 adults.

Also in 2017, additional adults (100) were taken to the Prince George site (McLeod Lake) and released approximately 60 m from the original release point in a slightly different micro-habitat.

Field results

Same year establishment was found at all three 2014 spring releases located at Elkford, Cranbrook and Prince George when monitored for galls in June, July and August. The following year these same sites were monitored and successful overwintering was confirmed, however, the overall gall count was lower.
The Cranbrook site encountered heavy grazing and trampling by cattle which may have contributed to the reduction of galls from 0.56 galls / minute (June 2014) to 0.033 galls / minute in June (2015) and 0.19 galls/minute in July (2015). The 2015 June monitoring occurred nearest the release point on a hot, exposed, nearly level and unprotected location which was trampled and grazed by cattle. Sampled plants were quite dried. The July monitoring mainly covered an area near or within a small, narrow, steep-walled, water-receiving depression with little evidence of cattle disturbance. Sample plants also appeared to suffer less heat and drought stress.
At the Elkford site the gall count also declined from 1.55 galls / minute (2014) to 0.21 galls/minute in June (2015) and only 0.011 galls/minute in July (2015). It was speculated the decline of galls found in July versus June of 2015 at Elkford was potentially influenced by prolonged high temperatures and lack of precipitation resulting in brittle plants from which galls could easily snap off and become hidden under plant litter and debris.
The Prince George release site yielded 5 galls / minute in June 2014 and 1.28 galls / minute in August 2014, however, in August 2015 only 0.49 galls/minute were found.
Although the overall gall count was down over one year, the distance the agent spread away from the release point increased at two of the sites and slightly decreased at the third site from: 11 m (2014) to 24 m (2015) at Cranbrook; 17 m (2014) to 68 m (2015) at Elkford; and, 15 m (2014) and 14 m (2015) at Prince George. The three 2015 spring releases made near Kitwanga and Golden were monitored in August 2015 and same year establishment was confirmed. At Golden, 0.91 galls / minute were found. At the two Kitwanga releases, the vacant lot site yielded 0.43 galls / minute and the cemetery site yielded 1.23 galls / minute. The releases at Quesnel and Prince George (McLeod Lake) have shown good establishment and may yield sufficient numbers of galls for future collections, however, populations are expected to continue to be supplied from the rearing colony in Lethbridge, Alta. for several years.

Fig. 4. *R. pilosa* release near Elkford (Montane spruce zone)

Fig. 5. *R. pilosa* release near McLeod Lake (Prince George area) (Sub-boreal spruce zone)

NOTES

- *R. pilosa* adults may also feed on *L. dalmatica* but it is less preferred than *L. vulgaris*[2].
- In "no-choice" host specificity screening studies, when *R. pilosa* oviposited into *L. dalmatica* plants, the plants reacted with a defense mechanism that rejected the insect or the gall-inducing factors and subsequently ejected the egg from the stem[2].

REFERENCES

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