

Aulacidea subterminalis Niblett

INVASIVE SPECIES ATTACKED: King devil hawkweed (*Pilosella floribunda* Wimm. & Grab)
Mouse ear hawkweed (*P. officinarum* Vaill.)
Orange hawkweed (*P. aurantiaca* L.)
Whiplash hawkweed (*P. flagellaris* Dumort.)

TYPE OF AGENT: Gall forming wasp

COLLECTABILITY: Not available for general distribution

ORIGIN: Germany

DESCRIPTION AND LIFE CYCLE

Adult:

Aulacidea subterminalis are parthenogenic (only females are produced). Adults are very small and measure about 2–3 mm long. The female wasps have stout, dark brown to black coloured bodies. The abdomen is lighter coloured than the rest of the body and legs. With some magnification, minute hairs can be observed on the head and thorax. The abdomen is relatively smooth with the exception of two patches of pale coloured hairs located near the front. They have membranous wings, a laterally compressed body, and a short projecting ovipositor. *A. subterminalis* is capable of only producing one generation per year. In Switzerland, two years of combined data from the rearing process showed the adult wasps' emergence range occurred from early May through June and into early to mid-July. The females produce 28 to 145 eggs each (average 84.5) and oviposit an average of seven eggs at each oviposition point. They prefer to oviposit into stolon tips, but, on occasion they will also lay eggs into plant leaves. It takes the female anywhere from 1 hour and 40 minutes to 2 hours and 15 minutes to complete a single oviposition. The life span for an adult in the lab is up to one week³.



Fig. 1. *A. subterminalis* adult on orange hawkweed stem

Egg:

The minute eggs are milky white coloured. They measure about 0.24 mm long and 0.09 mm wide and have a 1.18 mm long stalk³.

Larva:

Each larva develops within their own gall. Mature larva are, to some extent, fusiform (being tapered at both ends) and have a distinct head that lacks pigmentation. The lower jaw (mandible) is conspicuous and has pigmented tips. About five weeks after oviposition has occurred, the galls can be observed, generally in late July. Typically, the galls measure 4.5 mm in diameter, however, when multiple eggs are laid and the larvae develop, it may cause single galls to fuse together and form a larger gall structure. The galls develop over a 10 week period. The larva overwinter inside the gall and pupation occurs the following spring in April³.

Pupa:

Pupation occurs inside the gall the following spring in April³.

Overwintering stage:

Mature larva overwinters inside the gall³.

EFFECTIVENESS ON HOST PLANT

The formation of galls causes the plant to divert nutrients away from other plant tissues. In some conditions, galling biocontrol agents can stress the plant and subsequently cause the plant to have reduced competitiveness, seed production and long-distance spread of the plant.

To test *A. subterminalis* effectiveness, New Zealand carried out several stress and stress free experiments on mouse ear hawkweed. The studies indicate that *A. subterminalis* may cause a reduction in the plant's ability to reproduce using vegetative means.

- In the stress free shade glasshouse experiment they found the plants with galls had reduced stolon length by 75% and had slight reductions in total dry matter and root weight.
- In the glasshouse water stress and nutrient stress experiment it was observed that galled plants produced more stolons, however, the stolons were shorter and had more branching than plants with no galls. Also noted was the size of the gall clusters were not significantly different between the treatment and control plants.
- In the glasshouse plant competition stress experiment, total stolon length relative to plant biomass was measured and determined that plants with galls produced thinner stolons³.



Fig. 2. Single current season gall on whiplash hawkweed

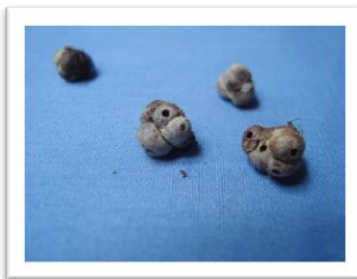


Fig. 3. Multiple previous year gall clusters with exit holes



Fig. 4. Multiple gall cluster on whiplash hawkweed

HABITAT AND DISTRIBUTION

Native:

In northern Europe, *A. subterminalis* is quite common and widespread on mouse ear hawkweed. In its native range, *A. subterminalis* is found on mouse ear hawkweed in arid, low nutrient grasslands, inland dunes, low fertile upland pastures, and artificial heaths. Records indicate its range includes Britain, France and Germany³.

North America:

In North America *A. subterminalis* is expected to fit within much of the target host plants' range. *A. subterminalis* establishes well in areas with more moisture. It may not be well adapted to survive in dry or drought conditions that may force plants into early senescence³. Information provided in CABI screening reports on tests using North American host plants, indicates the gall wasp appears to have a stronger preference for mouse-ear hawkweed over orange hawkweed².

British Columbia:

The releases made into B.C., both the propagation and the field releases, occur in the Interior cedar-hemlock and Interior Douglas-fir and the Sub-boreal spruce biogeoclimatic zones. To date, all releases in the Interior cedar-hemlock and the Interior Douglas-fir have shown establishment. It is too early to determine the agents preferred habitats and its favoured geographic range in B.C.

BRITISH COLUMBIA RECORD

Origin:

The original source of *A. subterminalis* introduced to North America, including those brought into B.C., originated from a colony reared at the CABI-Europe facility in Switzerland from collections made in Germany's Black Forest region³. The *A. subterminalis* imported to B.C. came first from CABI and was then lab-reared at Agriculture and Agri-Food Canada (AAFC) in Lethbridge on mouse ear and orange hawkweeds.

History:

The first two *A. subterminalis* releases made in B.C. occurred in June 2011. The first release was made with 397 larvae and pupae infested galls into two orange hawkweed tented propagation plots located at the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) property near Salmon Arm, B.C. At this same time, a field release of 414 larvae and

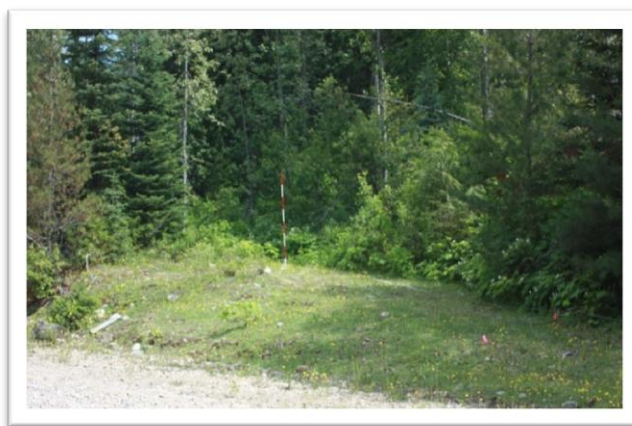


Fig. 5. Established *A. subterminalis* release south of Three Valley Gap (Interior cedar hemlock zone)

pupae infested galls that were reared on mouse-ear hawkweed was also made near Malakwa where four hawkweed species were established: whiplash, orange, tall and meadow. At the site, the galls were purposefully released within clumps of whiplash plants to help ensure their survival and to see if *A. subterminalis* would later transfer to neighbouring orange hawkweed plants.

Propagation results:

In June 2011, 252 pupae infested galls originally reared on mouse ear hawkweed were released in one tent and 145 galls reared on orange hawkweed were put into another tent. After the initial *A. subterminalis* release in June, the propagation tents were left unattended for two weeks to avoid disturbing the galls and the emerging adult females. Consistent routine plot tending resumed after the two week period. In late August, the plants were monitored weekly for early gall formation. To determine if same year establishment had occurred, the plots were monitored extensively in late September, and again in early October, but, no galls were found. The galls are extremely difficult to detect on orange hawkweed plants when the plants are still green¹. During the September monitoring process several of the galls released in June were relocated and exit holes were found. In spring 2012, a thorough inspection revealed a few overwintered galls. Autumn inspections carried out each year indicate a low level of establishment on orange hawkweed with only a few current year galls or suspected gall formations found.

Field results:

The first field release site was revisited in autumn to determine if same year establishment had occurred. Late September monitoring of whiplash hawkweed patches at and near the release point revealed a single gall formation. In early October, the site was revisited and an additional nine galls were located on whiplash hawkweed. However, no galls were found on the orange hawkweed plants on the site. The meadow and tall hawkweed on this site were not monitored. During this monitoring session, several of the galls released in June were relocated and exit holes were observed. The field site was revisited the following year (2012) in late spring and it was determined that autumn was optimal for monitoring. Since 2011, seven *A. subterminalis* releases have been made on whiplash hawkweed field sites and as of 2017, all release sites except one have established. In 2015, a release was made between Blue River and Valemount and later supplemented with additional galls in 2016, however, it has not yet been found established. All *A. subterminalis* gall shipments received in 2017 were used to supplement existing releases.



Fig. 6. *A. subterminalis* release near Sicamous (Interior cedar hemlock zone)

NOTES

- Commonly referred to as the hawkweed gall wasp³.
- The populations shipped to New Zealand and North America all originate from the same gene pool originally collected from the Black Forest in Germany³.

REFERENCES

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2. Grosskopf, G., S. Butler, H. Recher and H. Schneider. 2002. Biological control of hawkweeds, *Hieracium* spp. annual Report 2001. CABI Bioscience, CAB International
3. Littlefield, J., G. Grosskopf, and L. Wilson. 2008. A petition for the field release of the gall wasp *Aulacidea subterminalis* (Hymenoptera: Cynipidae) for biological control of invasive hawkweeds in North America.