

Agapeta zoegana L.

INVASIVE SPECIES ATTACKED: Spotted knapweed (*Centaurea biebersteinii*)
Diffuse knapweed (*C. diffusa*)

Operational Field Guide: *Agapeta zoegana* – Operational Field Guide, B.C. Ministry of Forests and Range.

TYPE OF AGENT: Root feeding moth

COLLECTABILITY: Mass

ORIGIN: Austria and Hungary

DESCRIPTION AND LIFE CYCLE

Adult:

Adult moths are bright yellow and black. They are 1 - 2 cm long and have a wingspan that measures 1.5 - 2.3 cm. Forewings are bright yellow with brown-black markings; hind-wings are dark grey. The females have a larger and more rounded abdomen than the males. The males have a pair of clasping pincers at the end of their abdomen. Adults emerge from roots during mid-June to mid-August and begin to mate and lay eggs within 24 hours. Females oviposit 66 - 185 eggs individually or in groups of two or three onto leaves or stems close to the crown, selecting plants with a root diameter of 2.4 mm or larger. Temperatures between 18 - 30°C are best for mating. Cool, windy days will delay oviposition. Adults live 10 to 14 days. Peak emergence periods are in early mornings or evenings. Adults rest low on the plants or on the soil surface during the day. Disturbing the plants will cause the adults to take short flights.



Fig. 1. *A. zoegana* adult (credit Powell et al. 1994)

Egg:

Eggs are initially white and turn yellow-red after four days. They are flattened, oval shaped, measuring 0.75 mm x 0.45 mm. With magnification, a network of meshed lines can be observed on the outer egg surface. Eggs hatch in seven to ten days.



Fig. 2. *A. zoegana* larva (credit Powell et al. 1994)

Larva:

The larvae are segmented, with white bodies and brown heads. Newly hatched larvae move to the root crown to begin feeding. The larvae develop through six instars. The first through fourth instars mine about 10 cm of the taproot over 40 - 45 days. As they mine the outer root layers, they produce a whitish web tunnel that encloses around the larvae as they create a spiral trail downward before they return towards the top of the root. If they require additional food, the larvae can move through the soil to adjacent roots within 10 cm. In 70 days the larvae will be mature in their sixth instar.

Pupa:

Pupation takes about eight weeks which occurs the following spring within the webbing. Multiple larvae can exist on a single root.

Overwintering stage:

It will overwinter in any larvae instar within the root.

EFFECTIVENESS ON HOST PLANT

Agapeta zoegana larvae feed on the outer layers of the root, creating spiral tunnels which can kill small plants and prevent the flowering of larger ones. When the larvae enter the root, they often damage the vegetative stem bud, causing the plant to send up multiple short stems instead of a single bolt. Plants may become susceptible to secondary insect or pathogen attack.

HABITAT AND DISTRIBUTION

Native:

Its native distribution includes the former Yugoslavia, eastern Romania, western Hungary and eastern Austria. Small populations occur in the Upper Rhine Valley, but it is absent in the Swiss Valais.

North America:

A. zoegana has established in a wide variety of habitats in Canada and the United States since it was first introduced as a biocontrol agent in the early 1980's.

British Columbia:

Records indicate releases have occurred in the Bunchgrass, Coastal Douglas-fir, Coastal western hemlock, Coastal mountain-heather Alpine, Interior cedar-hemlock, Interior Douglas-fir, Interior mountain heather alpine, Montane spruce, Ponderosa pine and Sub-boreal spruce biogeoclimatic zones. Establishment and dispersal have been found throughout each of these zones with the exception of the Interior mountain heather alpine, Montane spruce and Sub-boreal spruce zones. *A. zoegana* is common to the mesic, cooler areas where knapweed grows. Often it is associated with sites that have moderate humidity and temperatures within the Bunchgrass and Ponderosa pine biogeoclimatic zones. It can tolerate low winter temperatures, but it requires a long growing season. The literature states that sites over 1,000 m may not allow sufficient time for development. Suitable host plants have 2.4 mm diameter roots growing in undisturbed locations that are not mowed, grazed or cultivated.

BRITISH COLUMBIA RECORD

Origin:

Populations released in Canada originate from Austria and Hungary.

History:

The first *A. zoegana* release was made in 1982. Since then, thousands of adult moths have been collected and redistributed throughout the province. In 1998, *A. zoegana* received secondary status. Assisted redistribution is ongoing.

Field results:

A. zoegana is well dispersed in the southern interior and can be seen frequently from mid June through mid August. Many larvae can be found on a single root, for example, 56 *A. zoegana* larvae were found on a large root (over 20 cm long). Twenty-eight *Cyphocleonus achates* larvae were also present on this same root. Recent observations have shown, that despite the presence of, and sometimes the significant number of, larvae in the root, adult moths are difficult to find in collectable numbers.

Collection for redistribution:

Using light suction, adults can be aspirated head first into prepared collection containers. Peak emergence periods are in early mornings or evenings. Adults rest low on the plants or on the soil surface during the day. Disturbing the plants will cause the adults to take short flights.

NOTES

- *A. zoegana* can exist with other root feeding biocontrol agents, including *Sphenoptera jugoslavica* and *Cyphocleonus achates*.

REFERENCES

1. Harris, P. 2005. Classical biological control of weeds established biocontrol agent *Agapeta zoegana* (L.) Root-cortex feeder. Agriculture and Agri-Food Canada. Updated August 3, 2005. http://res2.agr.ca/lethbridge/weedbio/agents/aagapzoe_e.htm (Accessed January 15, 2007).
2. Muller, H., D. Schroeder and A. Gassmann. 1988. Investigations on *Agapeta zoegana* Haw. (Lep.: Cochyliidae), a possible biocontrol agent of spotted knapweed *Centaurea maculosa* Lam. (Compositae) in Canada.
3. Powell, G. W., A. Sturko, B. Wikeem and P. Harris. 1994. Field guide to the biological control of weeds in British Columbia. Land Manage Handbook No. 27. B.C. Min. For. Res. Prog.
4. Turner, C.E., J.M. Story, S.S. Rosenthal and N.E. Rees. 1996. *Agapeta zoegana*. Sect. II, The knapweeds. In: Biological control of weeds in the west. N.E. Rees, P.C. Quimbly Jr., G.L.Piper, E.M. Coombs, C.E. Turner, N.R. Spencer, and L.V. Knutson, (editors). Western Soc. Weed Sci.
5. Winston, R., C. Bell, R. De Clerck-Floate, A. McClay, J. Andreas and M. Schwarzlander. 2014. Biological control of weeds in the northwest. Forest Health Technology Enterprise Team.