

Cyphocleonus achates (Fahr.)

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

Operational Field Guide: *Cyphocleonus achates* – Operational Field Guide, B.C. Ministry of Forests and Range.

TYPE OF AGENT: Root feeding beetle (weevil)

COLLECTABILITY: Limited

ORIGIN: Austria, Hungary and Romania

DESCRIPTION AND LIFE CYCLE

Adult:

Cyphocleonus achates adult weevils measure 0.8 - 1.75 cm and at first have dark reddish-brown soft bodies. In a few days their bodies harden and they become grey-brown. Their colouring allows them to camouflage on dried plants, floral bracts and soils. Females have a rounded abdomen while the males are flattened. They are rapid walkers which compensates for their inability to fly. Adults emerge from roots in mid-July; peak in August, then taper off into September. The earliest quantity of emerging weevils has a higher ratio of males, later the ratio becomes equal, and near the end of the season more females are present. Mating begins within one or two weeks of emergence and egg-laying begins in August. Females mate repeatedly and oviposit an average of 45 eggs over their entire 10 week life span. The procedure to lay each egg takes about 25 minutes to complete. Females excavate head first, 10 - 20 mm into soft soil and chew an attachment location on the plant crown. Then they back out and reverse into the site to deposit a single egg, cementing it in place with soil particles. Usually the females will fill the excavation before moving on to repeat the process. If the females do not backfill, another female will often use the prepared site to oviposit another egg.

Egg:

The oval eggs are 1.76 x 1.24 mm. Initially, they are white or pale yellow and darken during incubation, which takes 10 - 12 days.

Larva:

The larvae are plump, creamy white or yellowish, with large, light brown head capsules. Similar to most weevils, they retain a "C" shape. There are four larval instars. Upon hatching, new larvae mine inward to the root core. The first two instars feed within roots until fall and then rest, overwinter and resume feeding the following spring. Third and fourth instars cause the root to swell and enlarge. Several larvae on one root create large, linked formations, 2 - 4 cm long x 1 cm wide.



Fig. 3. Naked pupa of *C. achates* in knapweed root

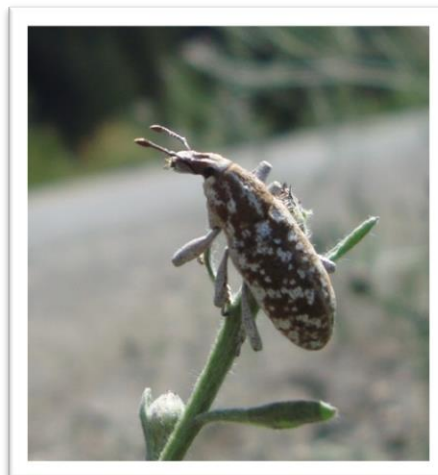


Fig. 1. *C. achates* adult on spotted knapweed



Fig. 2. *C. achates* larvae in spotted knapweed root

Pupa:

Pupation occurs in late spring or early summer, lasting about two weeks. The emerging generation adult weevils chew through the root and crawl to the surface.

Overwintering stage:

Second instar larvae overwinter in the root.

EFFECTIVENESS ON HOST PLANT

Larvae mine the plant roots which notably reduce the plants ability to dispense energy used to produce shoot growth. Studies indicate that two larvae/spotted knapweed rosette reduces shoot biomass by 65%. Larvae feeding cause plants to become shortened, producing fewer flowers and less seeds. Adult feeding on leaves, especially on young leaves, reduces plant vigour. As plants become smaller or die, more soil surface becomes

exposed, increasing heat absorption which further enhances *C. achates*' preferred environment. Once new weevils leave the root, their exit holes allow an entry point for secondary attacking pathogens.

HABITAT AND DISTRIBUTION

Native:

Its native distribution includes areas in eastern and southern Europe and Asia Minor. It is found in the former Czechoslovakia, Austria, Hungary, Romania, Bulgaria, Greece, Turkey, Syria and the former USSR.

North America:

C. achates prefers hot and dry habitat, with loose, well-drained, coarse soils. It establishes in undisturbed bunchgrass habitat, favouring bare soil surfaces where grasses do not crowd the target plants. It shows a preference for spotted knapweed over diffuse knapweed. Sites need to be somewhat large with a corridor of plants for it to disperse to by walking.

In 1987, *C. achates* was initially released in Canada in B.C. and Alta. In 1998, additional releases were made in the U.S.A. in Calif., Colo., Idaho, Mont., Nev., Oreg., Utah, Wash., Wyo. *C. achates* successfully established in Utah on squarrose knapweed (*C. virgate* (Lam.)). *C. achates* was released on meadow knapweed in 1998 in Oreg. and in 2007 in Wash., but both releases have not established. *C. achates* has not established on meadow knapweed in B.C. and it is speculated meadow knapweed roots is unable to support the large larvae.



Fig. 4. *C. achates* feeding cavity in knapweed root



Fig. 5. *C. achates* feeding cavity in knapweed root



Fig. 6. Established *C. achates* release site in North Thompson near McLure (Ponderosa pine zone)



Fig. 7. Established *C. achates* release site at Kamloops (Bunchgrass zone)

British Columbia:

In B.C., *C. achates* has been released in the Bunchgrass, Boreal white and black spruce, Coastal Douglas-fir, Coastal mountain-heather alpine, Coastal western hemlock, Engelmann spruce-subalpine fir, Interior cedar hemlock, Interior Douglas-fir, Montane spruce, Ponderosa pine and Sub-boreal spruce biogeoclimatic zones. Establishment has occurred at release and dispersal sites in all these zones except the Boreal white and black spruce zone.

BRITISH COLUMBIA RECORD

Origin:

C. achates released in B.C. originate from Austria, Hungary and Romania.

History:

C. achates was first introduced into B.C. in 1987. This first shipment was released into rearing tents in Kamloops, open rearing plots at Castlegar and a field release in the south Okanagan. In 1988, an open field release made in Kamloops later became a collection source in 1991. Over time several sites became premium collection sources, producing thousands of adults for redistribution. In 10 years (1987 - 1997) 18,487 weevils had been collected for redistribution. In 1996, B.C. shipped 529 weevils to Brocket, Alberta for a field release, however, status of this site is unknown. Assisted redistribution is still ongoing in B.C.

Field results:

C. achates successfully establishes with other bioagents. It has been found co-existing in sites with three other root feeders: *Agapeta zoegana*, *Pterolonche inspersa* and *Sphenoptera jugoslavica*, as well as with the seed feeders - *Larinus minutus*, *L. obtusus*, *Urophora affinis*, *U. quadrifasciata* and *Metzneria paucipunctella*, and the stem/leaf rust *Puccinia jaceae*. Historically, *C. achates* mating was not observed before the first week of August, and egg-laying followed in the third week, however in recent years, weevils are present in collectable numbers by the end of July. When occurring in high quantities, sites with *C. achates* have shown to decrease the plant density and its overall height at many spotted knapweed sites. The greatest impact at *C. achates* sites is noticed when other biocontrol agents are also present.

Collection for redistribution:

Hand picking adults off plants allows for the immediate sorting of sexes if required. If collection occurs when the sex ratio is in favour of the males, efforts are not as efficient as release sites will not receive as many ovipositing females. Collection is best done when the ratio is either equivalent or favours the females. Care must be taken, however to not collect too late in their season as females would have already laid their eggs. Hand collecting is rapid and successful once the technique and weevil behaviour is learned. Adults congregate on host plants and other vegetation, often in pairs. Shadows and plant disturbance causes them to drop and feign death. They will move away from potential danger by moving behind stems and circling out of view. Sweeping for adults can be done, but increases the chance of damaging the adults.



Fig. 8. Established *C. achates* release area near Savona (Interior Douglas-fir zone)



Fig. 9. *C. achates* adult (credit Powell et al. 1994)



Fig. 10. *C. achates* pupa (credit Powell et al. 1994)

NOTES

- *C. achates* can exist with *A. zoegana* and the two work better in conjunction than on their own. *A. zoegana* prefers dense knapweed stands and their attack decreases the plant size, which exposes more soil surface, and in turn results in higher soil temperatures and preferred *C. achates* habitat.

REFERENCES

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