

Cassida rubiginosa Muller, 1776

INVASIVE SPECIES ATTACKED: Canada thistle (*Cirsium arvense* (L.))
Nodding thistle (*Carduus nutans* L.)
Plumeless thistle (*C. acanthoides* L.)

TYPE OF AGENT: Foliar feeding beetle

COLLECTABILITY: Not permitted

ORIGIN: Unknown

DESCRIPTION AND LIFE CYCLE

Adult:

Live *Cassida rubiginosa* adults are bright green on their upper side (dorsal) with a brown spot located at the center of their wing covers and are black on their underside^{2,3}. The lower edge of the dorsal surface is usually hemmed with a yellowish margin. Dead specimens quickly change to a brownish colour. Mature adults are 6–8 mm long and have irregular dimpling over their entire dorsal surface³. Females are slightly larger than males².

Overwintered adults begin to emerge in early spring. According to the Canadian National Collection (CNC) the earliest adult collection dates occurred in Ontario on April 2 (southern Ontario) and in Ottawa on May 15. In the Maritime Provinces, the earliest collection occurred on May 31 (Kentville, NS). In their native range in Europe, *C. rubiginosa* females begin ovipositing 3-7 days after mating, which may be influenced by temperature, day length, rain and wind³. Generally females will oviposit over a 15 week period beginning in mid March and ending in early July^{3,4}.

However, in New Zealand where *C. rubiginosa* has been intentionally released for the biocontrol of Canada thistle, the females lay eggs for a six week period that is separated with a seven week break during the warmer months². In a lab study, each female had an average of 815 eggs. The females typically oviposit near the mid-rib on the underside of the plant leaves and there is some indication there may also be a preference for leaves closest to the soil. In a research study, 74% of all ovipositing occurred on the underside of the leaf. In some instances the eggs are also oviposited onto the upper leaf surface and onto the plant stem. The eggs are usually laid in small clusters in a protective outer covering called an ootheca (oothecae-plural). Most often each cluster consists of three eggs, however, it is not unusual to find more eggs or even a single egg present in each ootheca. In a lab research project an average of 4.6 eggs were found in each ootheca and 51.1 oothecae were laid by each female. As each egg is laid it is covered with a secretion that, within 10 minutes, changes their original whitish color to brown. After the female has laid sufficient eggs for one cluster and before she moves on to another location she then closes the ootheca with her excrement which is believed to hide the eggs or to provide a physical or chemical barrier that may repel predators and possibly reduce egg mortality³. In a research study carried out in the United States there was evidence that adults tend to initially disperse themselves by walking as opposed to flying which results in the females ovipositing in the immediate area they were released into. In this same study, 95% of all oothecae were found within four meters of the release point⁵. In Europe, the new generation adults appear in mid-July and peak in late August which is similar to what is observed in Eastern Canada³. Adults are long lived and survive for about 80 weeks, and can be found on plants up to November^{2,4}. However, in Asia adults have been reported to still be alive after three years³. With the long life span and the pause in ovipositing during the warm months, there is opportunity for all life stages to be present at the same time².

Egg:

The elongated eggs are initially white, but, they quickly turn brown within the ootheca^{3,5}. At 18°C eggs hatch in two weeks and at 32°C eggs hatch in four days³.



Fig. 1. Adult *C. rubiginosa*



Fig. 2. Adult *C. rubiginosa* (underside)



Fig. 3. *C. rubiginosa* eggs on Canada thistle leaf



Fig. 4. *C. rubiginosa* eggs

Larva:

C. rubiginosa has five larval instars³. Initially, the larvae are creamy-white². The larva body is covered with distinct lateral spines and its posterior end has a forked appendage^{2, 3}. The forked appendage is used to accumulate and create a shield made up of the larva's own feces and the skins from each of its molts. The shield construction begins with the first instar molt when the shed skin is attached to the extreme end of the fork. As the larva feeds and grows, each molt is shed onto the next branch of the fork with the final largest molt attached closest to the base of the fork. Between molts the shield continues to increase with the accumulation of the larva's own feces. As the shield increases in size it arches forward overtop the larva's body. There are several theories for the role of the shield, the most likely being that is a protective mechanism. The larvae can move their shield to cover areas of the body that have been disturbed³. All five instars create window feeding damage on leaves. The first three instars feed on the underside of leaves and the fourth and fifth instars move to the upper leaf surface². The larvae postpone their main feeding phase until the normal value of the plant leaves' nitrogen content is reduced by 50% and the plant mass is increased by 30%. *C. rubiginosa* larvae are not very mobile and will typically spend their entire larval stage relatively close within the same area they initially emerged and will likely not move to another plant species³. In a research study, 95% of all larvae (and oothecae) were found within 4 m of the initial adults' release point⁵. Mature, fully developed larvae seek preferred pupation sites along the midrib of leaves or on the main stalk of the plant. At the onset of pupation, the larvae discard their shield, attach their last 2–3 lower abdominal segments to the plant, secure themselves into place with a sticky secretion and commence pupation³.



Fig. 5. *C. rubiginosa* larva waving its shield



Fig. 6. *C. rubiginosa* pupa attached to Canada thistle leaf.

Pupa:

The brown coloured pupae develop over three or more days depending on temperature. The average pupation takes 9.6 days (at 17.8°C) and 3.5 days (at 32.5°C)³. Development from egg to adult takes about 435 degree days above 10.4°C⁴.

Overwintering stage:

C. rubiginosa adults move to the soil surface in the fall and prepare to overwinter in debris and plant litter. In field cage studies the adults appeared to prefer leaf litter over other debris. Fluctuating winter temperatures combined with a lack of suitable hibernating locations and debris may result in higher than normal adult mortalities³.

EFFECTIVENESS ON HOST PLANT

C. rubiginosa adults and larvae feed on both the upper and lower sides of host plant foliage. Adults and older larvae prefer the upper leaf sides, whereas, early larvae instars tend to feed on lower leaf surfaces³. It was found in Maryland (U.S.A.) that in natural conditions *C. rubiginosa* can heavily defoliate Canada thistle plants⁵. In a Canadian research study the beetle decreased Canada thistle biomass when the plant was present in competing vegetation⁶.

HABITAT AND DISTRIBUTION

Native:

C. rubiginosa are native to Eurasia. Their wide native range includes Europe, eastern Mediterranean, North Asia and North Africa². At several Uzbekistan survey sites, *C. rubiginosa* were found to be one of the most common insects associated with Canada thistle growing in irrigated land and crop land¹.

North America:

In Eastern Canada, *C. rubiginosa* have been observed where Canada thistle stands tend to establish such as in agriculture lands, clear cut blocks, wooded forests, and abandoned farmland (fields and orchards). Their first recorded presence in North America occurred in Que. where they were found feeding on common burdock (*Arctium minus* (Hill) Bernh.). They are reported to be widely spread across Canada from Alta. to N.B. In the U.S.A. they are reported established from Virg. north to Maine and to the west through Ohio, S. Dak. and Wis³.

British Columbia:

C. rubiginosa has been recorded in the Bunchgrass, Coastal Douglas-fir, Coastal western hemlock, Interior Cedar hemlock, Interior Douglas-fir, Montane spruce, and Ponderosa pine biogeoclimatic zones on Canada thistle, nodding thistle, and plumeless thistle. The habitat investigation is ongoing.

BRITISH COLUMBIA RECORD

Origin:

The origin of the adventive population of *C. rubiginosa* found in B.C. is unknown.

History:

In 2009, Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) staff observed *C. rubiginosa* adults and larvae feeding on Canada thistle in Kamloops. Several adults were collected and subsequently positively identified by entomologists. This submission of adults was the first *C. rubiginosa* recorded sighting in B.C. The immediate source of those beetles found in B.C. is not known: whether they spread from other parts of Canada or came north from the United States.

Field results:

Since 2009, *C. rubiginosa* adults, eggs and larvae have been frequently found on Canada, nodding, and plumeless thistles in areas surrounding Kamloops, B.C. Sources indicate *C. rubiginosa* will feed on several non-native invasive thistles established in B.C, however, to date it has not been observed on bull or marsh thistles. At one Kamloops site, Canada thistle leaves were heavily skeletonized by adults and larvae. In the field during July, eggs, adults, and varying larvae instars were observed at a site near Kamloops. The larva can be enticed to wave their shield from side to side and forward and backward.

NOTES

- Common names for *C. rubiginosa* include shield beetle or green thistle beetle^{2, 4}.
- In ON and QU *C. rubiginosa* is capable of only one generation per year³.
- To date, there are six parasites known to attack *C. rubiginosa* larvae and pupae in North America³.



Fig. 7. *C. rubiginosa* “window” feeding evidence.



Fig. 8. *C. rubiginosa* adult on Canada thistle leaf

- In a Canadian study, when *C. rubiginosa* larvae were fed post-flowering Canada thistles leaves, the next generation adults did not go on to reproduce⁴.
- Early screening testing carried out in Canada showed that *C. rubiginosa* adults fed and oviposited on plants in the genera *Carduus* and *Arctium* and also fed on safflower⁴.
 - Studies have shown *C. rubiginosa* to feed on a wide variety of invasive and non-native plants and one native thistle including the following: *Arctium minus*; *Cirsium arvense*, *C. vulgare*, *C. pumilum*, *C. discolor* (native), *C. muticum* (native); *Centarurea jacea*; *Carduus nutans*, *C. crispus*, *C. acanthoides*; *Cynara*; *Carthamus*; and, *Silybum*³.

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