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Biocontrol Insects of Canada Thistle in the Northern Great Plains

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Identification guide

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This publication provides an easy-to-use identification guide to the primary biological control agents for Canada thistle in South Dakota and the northern plains. Only four of these agents are approved by both state and federal agencies for release in South Dakota. Photographs are provided for the identification of the adult, pupa, and larva of most species. Specialized terminology is limited to that deemed essential for identification and education.

The biocontrol agents released in this region represent two Orders of insects, the Coleoptera or beetles and Diptera or flies. These insects form the primary arsenal of biological control agents on Canada thistle in the northern plains at this time. Together, they are only slightly to moderately effective in controlling the thistle.

As with all biological control efforts, do not expect eradication of the weed. Yet, long-term suppression of the plant can be reasonably expected as long as the insect populations remain at high levels. Consequently, management of Canada thistle for the long term requires judicious appreciation for the benefits and limitations of biological control and integration with mechanical and chemical methods that can augment the insects for successful suppression of the weed.

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Photo Credits
Beetles (Coleoptera)

There are four species of beetle that occur as thistle control agents in the region. These beetles belong to the weevils (family Curculionidae) and leaf beetles (family Chrysomelidae). Only the weevils are widely distributed and generally found. The one leaf beetle seems to be barely holding its own in the Black Hills, but it is included here because of the potential for occurrence.

Flower-head weevil

Larinus planus

Recognition

This beetle is easily confused with the seed-head weevil, Rhinocyllus conicus. Compare their snouts.

Adult – Length is variable, 5–8 mm (ca. 1/4–3/8”). The body forms a narrow or elongate shape, with the sides straight or parallel. The rostrum or beak is easily visible in the dorsal aspect. The pronotum is roughly sculptured, and the elytra bear distinct striae that may have large punctures toward the base. The elytra typically have only thin patches of grey to white hairs. Older individuals appear entirely black due to loss of colored hairs. The antennae are inserted near the midlength of the rostrum.

Pupa – The pupa is approximately the same length as the adult and found within a cell formed in the receptacle of the flower head. The cell is unlined and easily crushed, being a loose cocoon, differing from that of Rhinocyllus conicus. The position of the pupal cell in the receptacle of the flower is diagnostic and can be confused only with that of R. conicus.

Larva – The larva of the seedhead weevil is a grub with a dirty white color. The maximum length is usually 8–9 mm. Its general form has the body strongly curved in a “C”. There is a large and distinctive head capsule. Since there are few hairs on the body, it appears naked and wrinkled. The larva is found feeding in the receptacle of the seedhead. Both the larva and pupa are similar and indistinguishable from those of R. conicus.

Biology and Plant Damage

There is one generation per year. Eggs are laid in the spring in holes made by the female in the bracts of host plant flowers. Egg to adult development varies widely from approximately 23–54 days. Adults are not very active from early July onward, usually hiding in leaf litter or in the soil, and overwinter in the same sites. Activity resumes in the spring, with mating and ovipositing on the host plants as flower heads develop. Adults will feed on fresh leaves of host plants. The adults fly well and are active on warm days.

The larva is the plant-damaging stage. Its weed control action is through general feeding on the flower-head, with destruction of the developing seeds and other flower tissues.

Sampling and Assessment Methods

Adult weevils can be netted or picked from the thistle plants. However, this is not efficient for assessing the population, and timing is critical as the adults are not available for more than a few weeks. Examination of flower heads for larvae and seed heads for pupae give a better indication of the extent of populations and can be quantified. Sampling can be done in the field by random selection of individual flower heads or by the picking of seed heads. Carefully tear open the flower head or seed head to reveal the larva or pupa.

Management

This species was originally released for control of Canada thistle and other thistles. The beetle is sporadically established and is not common in the northern plains. A greater level of host specificity of this beetle, as compared to R. conicus, reduces concerns about collateral damage to native non-pest thistle species. Collecting and redistributing this weevil to areas is encouraged, but local conditions may limit rapid development of a population.

Spring and early-summer herbicide use on Canada thistle is highly detrimental to weevil populations. The early death of thistle kills the developing larvae. Do not apply herbicide until the adults have left the plants. Similarly, mowing or grazing of thistle will hurt weevil populations if timing is wrong.

This weevil is highly susceptible to insecticides. Therefore, avoid using systemic insecticides, and do not apply contact insecticides after the adults begin emerging and before they enter their hibernation phase.
Recognize
This beetle is easily confused with the flower-head weevil, *Larinus planus*. Compare their snouts.

**Adult** – Length highly variable, 3–7 mm (ca. 1/4”). The body forms a narrow or elongate oval shape. The rostrum or beak is not easily visible in the dorsal aspect. The pronotum is roughly sculptured, and the elytra bear distinct striae that may have large punctures toward the base. The elytra typically have patches of tawny-colored hairs, but some specimens will have these hairs more generally distributed on freshly emerged individuals. The antennae are inserted before the tip of the rostrum.

**Pupa** – The pupa is approximately the same length as the adult and found within a cell formed in the receptacle of the flower head. This cell has a hard coat formed from cemented debris and fecal materials. The position of the pupal cell in the receptacle of the flower is diagnostic and can be confused only with the pupa of *Larinus planus*.

**Larva** – The larva of the seedhead weevil is a grub with a dirty white color. The maximum length is usually 7–8 mm. Its general form has the body strongly curved in a “C”. There is a large and distinctive head capsule. Since there are few hairs on the body, it appears naked and wrinkled. The larva is found at the same site as the pupa, that is, feeding in the receptacle of the seedhead.

**Biology and Plant Damage**
There is one generation per year. Eggs are laid in the spring on the bracts of host plant flowers. Typically, the larval stage lasts 45–55 days (ca. 4–6 weeks), while the pupal stage is 8–14 days. Adults are not very active from early July onward, usually hiding in leaf litter or in the soil and overwintering in the same sites. Activity resumes in the spring (April and May), with mating and ovipositing on the host plants where the beetles can be found, sometimes in abundance. The adults fly well and are active on warm days.

The larva is the plant damaging stage. Its weed control action is through the feeding on the receptacle of the flower-head and destruction of the developing seeds. Occasionally, mining of the flower stem immediately below the receptacle occurs.

**Sampling and Assessment Methods**
Adult weevils can be netted or picked from the thistle plants. However, this is not accurate for assessing the population and timing is critical as the adults are not available for more than a few weeks. Examination of flower-heads for larvae and seed-heads for pupae give a better indication of the extent of populations and can be quantified. Sampling can be done in the field by random selection of individual flowers or by the picking of flowers or seed-heads. Carefully tearing open the receptacle will reveal the larva or pupa. Adults can be found on the flower heads but are low in density and will not provide accurate assessments.

**Management**
This species was not originally released for control of Canada thistle. However, it is now commonly found on this plant throughout the region. The lack of host specificity of this beetle has created ecological concerns because of damage to native non-pest thistle species. The collecting and redistribution of this weevil to areas that may have native thistle species is not encouraged.

Spring and early summer herbicide use on Canada thistle is highly detrimental to weevil populations. The early death of thistle kills the developing larvae. Do not apply herbicide until the adults have left the plants. Similarly, mowing or grazing of thistle will hurt weevil populations if timing is wrong.

This weevil is highly susceptible to insecticides. Therefore, avoid using systemic insecticides, and do not apply contact insecticides after the adults begin emerging.
Recognition
This beetle is easily distinguished and not usually confused with other thistle feeding weevils in the region. *Hadroplontus litura* was formerly known as *Ceutorhynchus litura*.

Adult – Length is short, 3–3.5 mm (ca. 1/8–3/16”). The body forms a broadly oval shape, with the elytra having distinct shoulders giving a triangular silhouette. The rostrum or beak is not easily visible in the dorsal aspect, but it is strongly arched when viewed laterally. The dorsum is covered with scale-like hairs that give a cross-like mottled mixture of cream-white, grey, and tawny colors. The venter is covered with whitish hairs.

Pupa – The pupa is approximately the same length as the adult but is found within a cell formed in soil beneath or nearby a host plant. Its general appearance is similar to pupae of *Rhinocyllus conicus* and *Larinus planus*. The pupa could be confused with other soil pupating weevils that do not feed on thistle.

Larva – The larva of the seedhead weevil is a grub with a clear, yellowish color. The maximum length is usually 5–6 mm. Its general form is long and cylindrical; it has few, stiff hairs and appears naked and wrinkled. The larva is found, often in groups, in the pith of main stems of thistle. Young larvae bore leaf mid-veins and often kill the leaves. Larvae also will mine the crown and into roots.

Biology and Plant Damage
There is one generation per year. Eggs are laid in the early spring on new leaves, with egg laying occurring for 4–6 weeks. Typically, the larval stage lasts 4–6 weeks, while the pupal stage is another 1–2 weeks. Adults remain in the soil until late-mid to late summer and will feed on thistle stems and leaves. They overwinter in the soil and emerge in early spring. Spring feeding on new leaves, mating, and ovipositing begin with the emergence of new thistle rosettes. The adults fly well and are active on warm days.

The larva is the main plant damaging stage. Feeding by adults is inadequate to stress the plants. Weed control action is through the larvae boring and feeding on new leaves, crown, and roots of rosettes. In-the-crown feeding is done mostly to callus tissue formed around the burrows. Vigorous rosettes can tolerate one or a few larvae, but six or more larvae will kill even a healthy rosette. Stem boring rarely affects a mature plant. Plant damage is often attributed to secondary invaders, including nematodes, fungi, and other parasites, that enter through the bored stem tunnel.

Sampling and Assessment Methods
Adult weevils can be netted from the thistle plants. However, the beetles readily drop from the plants, so sampling must involve a single net swing from low to high on the plant. Adult sampling is is not efficient for assessing the population, and timing is critical as the adults are not easily sampled and are available for only a few weeks. Examining stems and crowns for larvae gives a better indication of the extent of populations and can be quantified. Sampling can be done in the field by random selection of individual stems or rosettes.

Management
This species was released for control of Canada thistle. However, it has not readily adapted nor become widespread. Although not host specific, the beetle does seem to prefer Canada thistle in our region. Note that the greatest effect of the weevil is on rosette-staged plants. Consequently, spring and early summer herbicide use on Canada thistle is highly detrimental to weevil populations. The early death of thistle kills the developing larvae. Do not apply herbicide until the adults have left the plants. Growth-retarding applications of herbicide may enhance weevil efficacy by retaining juvenile stages of the plant. Mowing or grazing of thistle is unlikely to hurt populations of this weevil. Redistribution may be done in August and September.

There may be greater numbers of weevil larvae on plants infected with rust fungus (*Puccinia punctiformis*).

This weevil is highly susceptible to insecticides. Therefore, avoid using systemic insecticides, and do not apply contact insecticides after the adults begin emerging.
Recognition
This species of weevil cannot be confused with any of the introduced biocontrol species on thistles. The small size and dark color throughout help separate them.

Adult – Length small, 1.8–2.1 mm (ca. 3/32”). The body forms a narrow or elongate oval shape. The rostrum or beak is usually easily visible. The pronotum is shiny with numerous dimple-like punctures. The elytra typically appear nude, but young adults do have scattered and very narrow cream-white scales and deeply grooved striae. The antennae are held beneath the rostrum and head when the insect is dead or feigning death.

Pupa – This life stage is not known for this species, but it is probably in the soil beneath host plants.

Larva – The larva of *Baris confinis* in thistles is not known, but it is surely a typical weevil larvae: white, C-shaped, and feeding on or within plant tissues.

Biology and Plant Damage
Adults are found active on Canada thistle, and possibly other species, in early summer. There is probably only one generation per year. Based on a very limited amount of information on adult activity, mating occurs in early summer, eggs are probably laid in early- to mid-summer, with larval feeding during the season and mature larvae overwintering in soil. This would have pupation in the spring. Adults were observed to feed on the edges of new and succulent leaves. Exactly where in the plant the larvae feed, and the extent of damage to plant tissues, remains unknown.

Sampling and Assessment Methods
At this point, there is a severe paucity of information on the life history of this species. Also, there are other species of *Baris* in the region, so any study will need to account for the species involved.

Adults of *Baris* species are sensitive to movement and will drop from the plant when approached. Although some specimens may be obtained by direct picking from plants, sweeping is a better method of sampling. Because the larval and pupal stages remain unknown for our local species, any investigations should probably include examination of stems, crowns, roots, and surrounding soil.

Management
*Baris confinis* is a native species and is not managed for biological control of thistles. Details on host specificity require more work, but so far the species has only been found on Canada thistle. This occurrence is of interest for two reasons: 1) because the plant is exotic and invasive, it is being attacked by a native species, and 2) we may have a native species of weevil to add to the biocontrol arsenal for Canada thistle.

This weevil is likely susceptible to insecticides, as are other species of thistle-feeding weevil. Therefore, to enhance the populations of this species, avoid applying insecticides around areas known to have the weevil.
** Recognition 
This beetle is unmistakable, being the only green, leaf-feeding beetle on Canada thistle in the region.

** Adult ** – Length is 6–7.5 mm (ca. 1/4”). The body forms a broad, slightly convex, oval shape reminiscent of a tortoise carapace. The entire dorsum is green, with much of the venter black. The head is tucked under the pronotum and is not visible from above. The legs also are hidden under the broad pronotum and elytra. The elytra are shiny and have rows of shallow punctures. Hairs on the dorsum are fine, pale, and difficult to see. The antennae are short.

** Pupa ** – The flattened brown pupa is approximately the same length as the adult and found attached to the underside of leaves or along the stem. It has soft black spines protruding from around the sides, and it flaps vigorously when disturbed.

** Larva ** – The larva is a shiny brownish-green, elongate, fleshy, and with numerous soft spines along the sides of the body, and it bears a forked tail. It is active on short legs as it feeds on thistle leaves. The maximum length is usually 7–8 mm. Its general conformation is spindle-shaped. There is a large and distinctive head capsule, but it is bent downward and sometimes difficult to see. The larva is found at the same site as the adult and pupa.

** Biology and Plant Damage **
There is one generation per year. Adults are long lived, often 1.5 years. Eggs are laid in the summer on leaves of thistle. Typically, egg to adult cycles are about six weeks. Adults are active whenever temperatures are warm. Adults overwinter in soil and leaf litter. Activity in the spring usually begins with feeding on new leaves of rosettes, with mating and ovipositing on the host plants as temperatures increase through the spring and continue into summer. The adults can fly well and are active on warm days. Both adults and larvae damage the host plant by defoliation.

** Sampling and Assessment Methods **
Adults, pupae, and larvae can be picked from the thistle plants. Since all life stages are found together on the host, quantitative sampling is straightforward. Sampling can be done in the field by random selection of plants or by subsampling of leaves for different life stages of the beetle.

** Management **
This species was not originally released for control of Canada thistle and is thought to be an accidental introduction to North America. It is not a commonly found beetle in the northern plains and the only known reproducing population in South Dakota is at a demonstration site in the Black Hills. The beetle is not host specific, but its apparent inability to develop significant populations in the region suggests that native thistles are not threatened.

Spring and summer herbicide use on Canada thistle is highly detrimental to tortoise beetle populations. Do not apply herbicide until the adults have left the plants for overwintering. Similarly, mowing or grazing of thistle will hurt beetle populations.

This beetle is highly susceptible to insecticides. Therefore, avoid using systemic insecticides, and do not apply contact insecticides after the adults begin emerging.
**Flies (Diptera)**

There are two flies released for field thistle control in the region, both in the family Tephritidae. These are the picture-winged fruit flies that are immediately recognized by the M- or W-shaped, dark banding patterns on the wings.

**Recognition**

This fly is readily identified by the larvae in the receptacle of the flower. The adult fly can be confused with similar fruit flies.

**Adult** – Length is highly variable, 3–5 mm (ca. 3/16”), with a 6–10 mm (1/4–3/8”) wingspan. The body is a yellow-orange throughout, with slightly darker bands on the abdomen. The wings are clear with a light brown W or M formation on each wing. The abdomen sports a 3 mm long and projecting ovipositor.

**Pupa** – The pupa is enclosed in a light-brown puparium that is ca. 4–5 mm in length. It can be found in the seed head during the spring and early summer, and it is often covered with seed-hairs.

**Larva** – The larva of the seedhead weevil is a translucent pale yellow to white-colored maggot. The maximum length is usually 4–6 mm. Its general conformation is elongate and slightly spindle-shaped. There is no discernable head capsule and the posterior respiratory plate is dark brown. Since there are few hairs on the body, it appears naked and evenly segmented. The larva is found in the seed head of the host plant during the summer and winter.

**Biology and Plant Damage**

There is one generation per year. Eggs are laid in the spring and early summer on thistle buds. Typically, the feeding larval stage lasts only two weeks, and then the larva wraps itself in seed hairs to form a hibernaculum in which it overwinters. This hibernaculum will fall to the ground or remain inside the receptacle. Pupae are long-lasting, sometimes taking upwards of 3 months before the adult emerges. Adults are active late spring through summer, with females ovipositing on buds. The adults fly well and are active on warm days.

The larva is the plant-damaging stage. Its weed control action is through the feeding on the receptacle of the flower-head and destruction of the developing seeds.

**Sampling and Assessment Methods**

Adult flies can be netted from the thistle plants. However, this is not efficient for assessing the population. Examining flower-heads for larvae and seed-heads for pupae gives a better indication of the extent of populations and can be quantified. Sampling can be done in the field by random selection of individual flowers or by the picking of flower or seed heads. Carefully tearing open the receptacle will reveal the larvae or pupae.

**Management**

This species is widely distributed and apparently entered South Dakota through natural dispersion. However, it is not credited with significant damage to Canada thistle, and it has a wide host range that may include native thistles. The collecting and redistribution of this fly is probably unnecessary as it seems to disperse readily and is already widespread.

Spring and early-summer herbicide use on Canada thistle is highly detrimental to fly populations. The early death of thistle kills the developing larvae. Do not apply herbicide until the larvae have completed their feeding period. Late-season mowing or grazing of thistle would probably not hurt fly populations.

This fly is highly susceptible to insecticides. Therefore, avoid using systemic insecticides, and do not apply contact insecticides after the adults begin emerging.
Recognition
This fly is readily identified by the plump larvae in large galls on the stems of Canada thistle. The adult fly can be confused with similar fruit flies.

**Adult** – Length is highly variable, 3-5 mm (ca. 3/16”), with a 9–10 mm (ca. 3/8”) wingspan. The body is a dark grey, with an orangish postscutellum between the wings. The wings are clear, with a dark brown to black W or M formation on each wing. The ovipositor is short and indistinct.

**Pupa** – The 4–5 mm long pupa is enclosed in a reddish-brown puparium. It can be found in the stem gall during the early spring and will last for ca. 3–4 weeks.

**Larva** – The larva of the stem gall fly is a translucent to pale, cream-white maggot. The maximum length is usually 4–6 mm. Its general conformation is plump to rotund, with blunt ends. There is no discernible head capsule, and the posterior respiratory plate is dark brown. Since there are few hairs on the body, it appears naked and evenly segmented. The larva is found inside the hard and roughly spherical stem gall on the host plant from summer through early spring. One to several larvae can be found within a single gall.

Biology and Plant Damage
There is one generation per year. Eggs are laid in the spring into the succulent new stems. The plant forms the gall around the larva that feeds on the undifferentiated tissue inside the gall. Typically, the feeding larval stages last about 4–6 weeks. The third instar larva overwinters in the gall. Adults are active late spring through summer, fly well, and are active on warm days.

The gall is formed as a plant response to oviposition and the presence of the larva feeding inside the gall. Weed control is through formation of the gall, which diverts energy from the upper plant parts and reduces or prevents flowering.

Sampling and Assessment Methods
Adult flies can be netted from the thistle plants. However, this is not efficient for assessing the population. Examining galls for larvae and pupae gives a better indication of the extent of populations and can be quantified. Sampling can be done in the field by random selection and picking of galls and by carefully sectioning these to examine the insect.

Management
This species, introduced into South Dakota for Canada thistle control, readily distributes naturally. Apparently, only Canada thistle is an acceptable host in the northern plains. On a local basis, collecting and redistributing this fly is best done by moving unopened galls to new areas in the autumn or spring.

Spring and early-summer herbicide use on Canada thistle is highly detrimental to fly populations. The early death of thistle kills the developing larvae. Do not apply herbicide until the larvae have completed their feeding period. Mowing or grazing of thistle would be highly detrimental to the fly if done before late summer.

This fly is highly susceptible to insecticides. Therefore, avoid using systemic insecticides, and do not use contact insecticides after the adults begin emerging.