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Agonopterix umbellana Gorse soft shoot moth

Agonopterix umbellana is a biological control agent approved in Hawai'i for release against common gorse.

SYNONYMS

Agonopterix ulicetella (Stainton)

CLASSIFICATION

RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Animalia	Animals
Phylum	Arthropoda	Arthropods
Class	Insecta	Insects
Order	Lepidoptera	Moths and butterflies
Family	Depressariidae	
Genus	<i>Agonopterix</i>	
Species	<i>Agonopterix umbellana</i> (Fabricius)	Gorse soft shoot moth

DESCRIPTION

Eggs are bright yellow, barrel-shaped, and 1 mm long. There are five larval instars. First to fourth instars are dark brown with dark spots on their sides. Fifth instars are olive green with dark side spots, and can be up to 20 mm long (Fig. 1a). Pupation occurs in silken feeding tubes. Adults are light

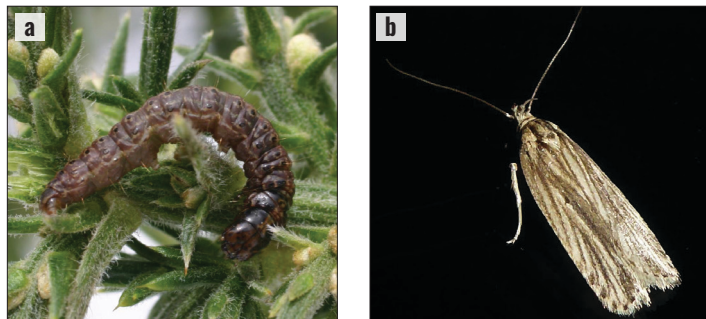


Figure 1. *Agonopterix umbellana* (a) late-instar larva; (b) adult (a: Eric Coombs, Oregon Department of Agriculture, Bugwood.org, CC BY-3.0 US; b: Aalbert Rebergen, iNaturalist.org CC BY-NC 4.0)

brown with dark brown or black longitudinal lines on the front wings that fade as the adult ages (Fig. 1b). Adults are typically 12 mm long with a wingspan of 21 mm, and they have long antennae varying from light to dark brown.

LIFE CYCLE

Overwintering adults emerge during late winter/early spring (Fig. 2) and lay eggs in gorse leaf and spine axils. Larvae hatch in late spring and spin silken tubes on gorse buds, feeding on new shoots and spines. Pupation occurs in the silken feeding tubes. Adults emerge in late summer and overwinter in gorse foliage. There is one generation per year.

DAMAGE

Attack by multiple larvae can defoliate an entire shoot and kill the developing tip (Fig. 3a,b). While this sometimes leads to dieback, plants frequently compensate by initiating

COMMON GORSE	FLOWERING PEAKS, PODS DEVELOP HIGH ELEVATION, SEEDS GERMINATE		PODS MATURE, LEAVES TO SPINES	SEEDS SPREAD, PLANT GROWTH/SPINE DEVELOPMENT CONTINUES				FLOWERING BEGINS AT LOW ELEVATION		FLOWERING HIGH ELEV., PODS DEVELOP LOW ELEV.		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Agonopterix umbellana</i> Adult	█											
Egg			█									
Larva				█								
Pupa					█							
Adult							█	█	█	█	█	█

Figure 2. Schematic life cycles of *Agonopterix umbellana* and common gorse in Hawai'i. This insect has not been released in continental North America. Bars indicate the approximate length of activity for each life stage; dates will vary depending on local conditions. Black bars represent the inactive and/or overwintering periods. There is typically one generation per year.

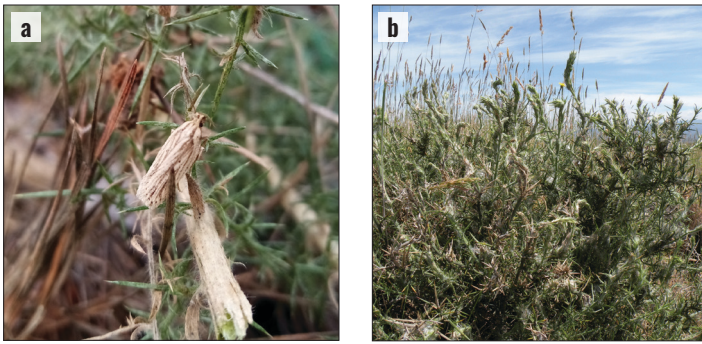


Figure 3. *Agonopterix umbellana* damage (a: Joe Potter Butler, iNaturalist.org CC BY 4.0; b: Fritz Grevstad, Oregon State University)

growth of new shoots later in the season when *A. umbellana* is no longer active.

FIELD IDENTIFICATION

Bright yellow eggs are laid in the axils of leaves and spines. Throughout spring, brown to olive green larvae (**Fig. 1a**) can be observed feeding on new shoots and spines of gorse and spinning silken feeding tubes in which they pupate. The light brown adults (**Fig. 1b**) can be observed overwintering in gorse foliage from late summer through early winter.

Agonopterix umbellana is established on gorse only in Hawai'i. A second *Agonopterix* species (*A. nervosa*) is established on both gorse and Scotch broom in continental North America, though it is not an approved biocontrol agent and should not be redistributed. Refer to the discussion of *A. nervosa* later in this document, under the section for unapproved agents, for more information about this related species.

PREFERRED HABITAT

In Hawai'i, the gorse soft shoot moth does best at high elevation sites, which is also where gorse is most problematic.

HISTORY AND CURRENT STATUS

Agonopterix umbellana was collected from England and released in Hawai'i beginning in 1988. A second population of warmer-adapted individuals collected from Portugal was released in 1991, in an attempt to increase establishment at lower elevation sites in Hawai'i. Both releases resulted in successful establishment, and subsequent records do not differentiate between the two populations.

This species is currently established on both Hawai'i Island and Maui (**Fig. 4**). It was initially widespread on Hawai'i Island, but an aggressive chemical/burning control program in 2001/2002 destroyed the gorse, resulting in a collapse of the *A. umbellana* population. The moth recovered and was again abundant by 2010. On Maui, this biocontrol agent is well established only at high elevations (> 3,280 ft or 1,000

m), where gorse is also most problematic. Overall in Hawai'i, while larval feeding can destroy a high percentage of gorse shoot tips and sometimes leads to dieback, impact is limited because of the new shoots produced once *A. umbellana* is no longer active. Parasitism may also contribute to low impact at some sites.

NONTARGET EFFECTS

None reported



Figure 4. *Agonopterix umbellana* reported distribution in the USA (Hawai'i only; Winston et al. 2021)

Exapion ulicis Gorse seed weevil

Exapion ulicis is a biological control agent approved in the USA for release against [common gorse](#).

CLASSIFICATION

RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Animalia	Animals
Phylum	Arthropoda	Arthropods
Class	Insecta	Insects
Order	Coleoptera	Beetles
Family	Brentidae	Straight-snouted weevils
Genus	<i>Exapion</i>	
Species	<i>Exapion ulicis</i> (Forster)	Gorse seed weevil

DESCRIPTION

Eggs are round, small, and translucent yellow. Larvae are cream colored with brown head capsules, C-shaped, and can reach 3 mm in length (Fig. 5a). Pupae are typically 3 mm long and cream colored, becoming dark gray with age. Adults are gray with very long, slightly curved snouts and brownish gray legs (Fig. 5b). Faint stripes are sometimes apparent on their elytra, and they are typically 2–3 mm long.

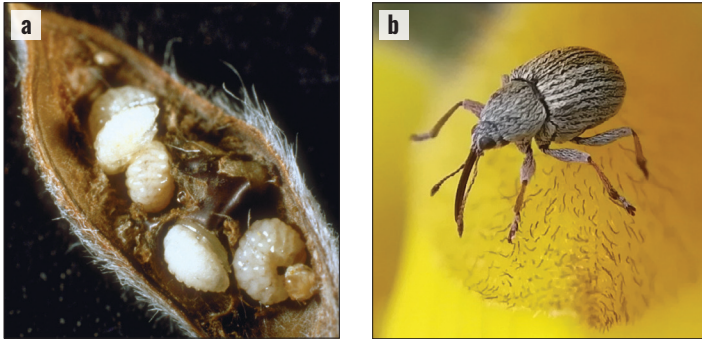


Figure 5. *Exapion ulicis* (a) larvae in a gorse seed pod, (b) adult (a: George Markin, USDA Forest Service, Bugwood.org, CC BY-3.0 US; b: Forever_failure, iNaturalist.org CC BY-NC 4.0)

LIFE CYCLE

In the continental USA, overwintering adults emerge during late winter or early spring, depending on location (Fig. 6).

COMMON GORSE		SEEDLING/ ROOT CROWN SPROUT	FLOWERING PEAKS	PODS MATURE, LEAVES REDUCED TO SPINES			PODS DEHISCE, SEEDS SPREAD				SEEDLING/ROOT CROWN SPROUT, FOLIAGE GROWTH		
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Exapion ulicis</i>	Adult												
	Egg												
	Larva												
	Pupa												
	Adult												

Figure 6. Schematic life cycles of *Exapion ulicis* and common gorse in North America. Bars indicate the approximate length of activity for each life stage; dates will vary depending on local conditions. Black bars represent the inactive and/or overwintering periods. There is typically one generation per year.

COMMON GORSE		FLOWERING PEAKS, PODS DEVELOP HIGH ELEVATION, SEEDS GERMINATE	PODS MATURE, LEAVES TO SPINES	SEEDS SPREAD, PLANT GROWTH/SPINE DEVELOPMENT CONTINUES				FLOWERING BEGINS AT LOW ELEVATION	FLOWERING HIGH ELEV., PODS DEVELOP LOW ELEV.				
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Exapion ulicis</i>	Adult												
	Egg												
	Larva												
	Pupa												
	Adult												

Figure 7. Schematic life cycles of *Exapion ulicis* and common gorse in Hawai'i. Bars indicate the approximate length of activity for each life stage; dates will vary depending on local conditions. There is typically one generation per year.

Adults feed on gorse flowers and foliage, causing shot-holes in petals, and deposit eggs into young seed pods. Larvae begin hatching in early to late spring and feed on developing seeds. Larvae develop through three instars. Pupation occurs in seed pods, and new adults emerge in late summer. Adults do not chew their way out of the seed pod, instead relying on the plant's dehiscing mechanism to escape. Seed pods dehisce, or dry out, and burst open at maturity in order to spread their seeds. Adults feed on spines and stems of gorse and then overwinter among gorse foliage. There is one generation per year.

In Hawai'i, both gorse and *Exapion ulicis* follow a different annual growth pattern compared to the continental USA (Fig. 7). All life stages occur earlier in the year, and some adult *E. ulicis* are active year-round in Hawai'i.

DAMAGE

Adults feed on gorse flowers (Fig. 8a,b) and foliage, which leads to the destruction of stem tissue but without significantly harming the attacked plant. Larval seed feeding (Fig. 8c) may reduce seed output. While this does not kill existing gorse plants, it can help reduce the rate of spread of gorse populations; however, the overall efficacy of this biocontrol agent is questionable due to high seed production and the longevity of viable seeds in the seed bank.

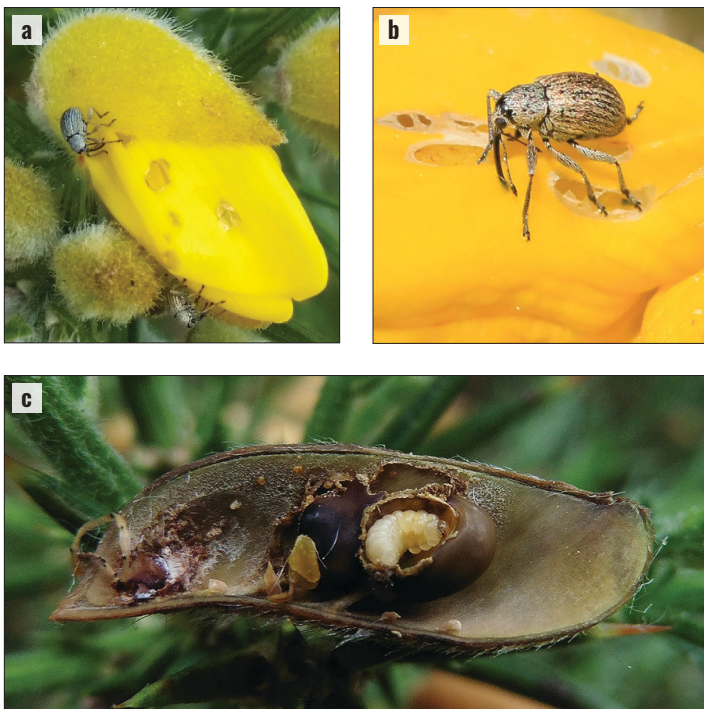


Figure 8. *Exapion ulicis* (a,b) adult feeding damage on a gorse flower; (c) larva and feeding damage to gorse seeds (a: Melissa Gunn, iNaturalist.org CC BY-NC 4.0; b: Sandy Rae, iNaturalist.org CC BY-NC-SA 4.0; c: Jesse_bythell, iNaturalist.org CC BY-NC 4.0)

FIELD IDENTIFICATION

Eggs are typically not visible under field conditions because they are laid within seed pods. When seed pods are opened, larvae can be observed feeding partly within and partly outside the seed (**Fig. 8c**). It is best to assess larval or pupal presence when pods are brown but not yet splitting open. Overwintered adults are readily visible in early spring as they feed on gorse stems and flowers (**Fig. 8a,b**). They are relatively fast for their size, and on warm days can be observed scurrying around gorse flowers.

PREFERRED HABITAT

Similar to its host plant, the gorse seed weevil does best in open, sunny sites and at locations with dense gorse infestations. Its distribution is limited in regions with cold winters, shade, and where host plants are only scattered.

HISTORY AND CURRENT STATUS

Exapion ulicis is native to Western Europe. In the continental USA, a population of *E. ulicis* sourced from England was released in California in 1953. After establishment, it was redistributed to both Oregon and Washington and successfully established in both states. In Hawai'i, two populations sourced from England and then England via New Zealand were released in 1926 and 1949, respectively. Both failed to establish. A third attempt sourced *E. ulicis* from more southerly regions in France to better match the climate in Hawai'i, and releases began in 1955. A fourth

attempt, again sourced from England, was released on the same islands in 1956. These third and fourth attempts were subsequently not differentiated in the literature, and it is assumed beetles from both established in Hawai'i.

The gorse seed weevil is widespread and abundant on gorse in the western USA (**Fig. 9**), though its overall impact is limited. From 30 to 95% of seed pods are attacked, and in 2019, a study of three sites in Oregon had a 51% seed attack rate. Seed reductions caused by *E. ulicis* likely do not reduce established stand densities, and at best may slow the rate of gorse spread. It is ineffective on seed maturing in autumn or winter. **This species is currently not known to be present in Canada.**

In Hawai'i, *E. ulicis* is established on Maui and Hawai'i Island (**Fig. 9**). Aggressive chemical/burning control programs have destroyed gorse at some locations, bringing about a collapse of the weevil populations, followed by a slow biocontrol agent recovery. Attack rates have varied by year on both islands. Annual attack rates of up to 95% of seed pods have had only limited impact on the invasiveness of gorse, likely due to the long-lived seed bank and subsequent plant recruitment.



Figure 9. *Exapion ulicis* reported distribution in North America (Winston et al. 2021)

NOTES

Parasitism may limit populations in some regions. In Hawai'i, feeding damage by *E. ulicis* may increase the susceptibility of gorse plants to a species of the pathogenic fungus *Colletotrichum*.

NONTARGET EFFECTS

None reported

Sericothrips staphylinus

Gorse thrips

Sericothrips staphylinus is a biological control agent approved in the USA for release against common gorse.

CLASSIFICATION

RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Animalia	Animals
Phylum	Arthropoda	Arthropods
Class	Insecta	Insects
Order	Thysanoptera	Thrips
Family	Thripidae	
Genus	<i>Sericothrips</i>	
Species	<i>Sericothrips staphylinus</i> Haliday	Gorse thrips

DESCRIPTION

Eggs are pale yellow, cylindrical, and ~0.3 mm long. There are two actively feeding nymphal instars and two inactive (non-feeding) instars. Nymphs are creamy-yellow and look increasingly similar to adults as they molt between instars (Fig. 10a,b). Adults are tiny (~1 mm long), black, and have circular white wing pads (Fig. 10a,b). They are typically wingless, though some winged individuals do occur. Winged forms are more abundant when population densities are high.

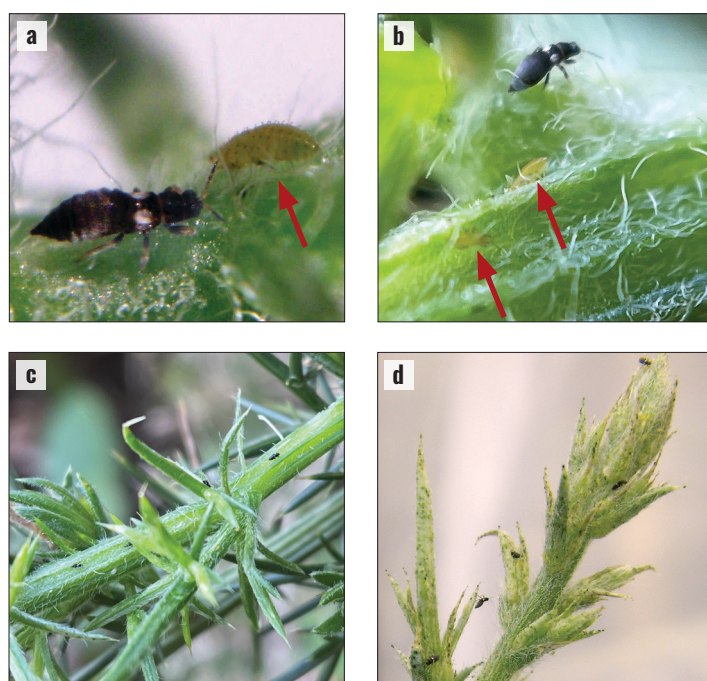


Figure 10. *Sericothrips staphylinus* (a,b) black adults and yellowish nymphs (arrows point to nymphs); (c,d) adults on gorse foliage (a,d: Fritzi Grevstad, Oregon State University; b,c: Jennifer Andreas, Washington State University Extension)

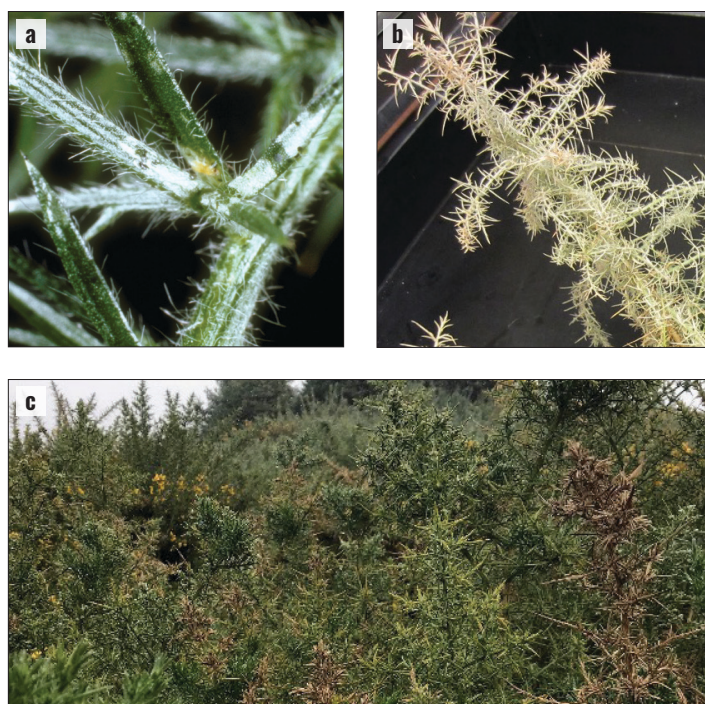


Figure 11. *Sericothrips staphylinus* feeding damage to gorse tissue (a) closeup; (b) in the laboratory; (c) in the field (a: George Markin, Bugwood.org, CC BY-3.0 US; b: Fritzi Grevstad, Oregon State University; c: Joel Price, Oregon Department of Agriculture)

LIFE CYCLE

Adults lay eggs in slits within young, actively growing branch tips. Gorse thrips complete multiple generations during the warmer months of the year. At cold, high-elevation sites, adults overwinter among gorse foliage. At low-elevation sites, adults are active throughout winter. The entire life cycle of a single generation is approximately 6–8 weeks. Adults and feeding nymphs puncture gorse stems and suck out the contents of mesophyll cells. This results in a mottled, blotchy appearance of attacked tissue (Fig. 11a,b).

DAMAGE

At high numbers, the gorse thrips can reduce gorse growth (Fig. 11b,c) and flowering and kill seedlings.

FIELD IDENTIFICATION

Eggs are typically not visible under field conditions because they are laid within stems. Yellow nymphs blend into the plants and are difficult to see (Fig. 10a,b). Although black and white adults are tiny, they can be observed feeding on gorse foliage throughout the year (Fig. 10c,d). Thrips are commonly found in sunny, warm locations on the upper tips of the plant (Fig. 10d).

If nymphs and adults are not readily observed, evidence of their feeding damage (mottled or dead gorse tissue [Fig. 11a–c] and tar-like frass spotting the plant material) may still confirm their presence. Keep in mind, however, that other

gorse biocontrol agents may cause similar damage. The gorse soft shoot moth, *Agonopterix umbellana*, which is presently established only in Hawai'i, and its unapproved relative *A. nervosa*, which is established in the continental USA and Canada, both damage the tips of attacked gorse plants (Fig. 3b, 19c). Shoots damaged by these species will be tied together with silk webbing, and finding larvae of either moth species can confirm if they are the cause of damage. The approved gorse spider mite, *Tetranychus lintearius*, which is established in both the continental USA and Hawai'i, also causes similar-looking tissue damage and can stunt gorse branch growth and reduce flowering. However, *T. lintearius* colonies always feed beneath large amounts of webbing (Fig. 15).

Similar-looking predatory thrips may also be present on gorse, but they are often shiny black, thin, and can have white bands (Fig. 12a). *Sericothrips staphylinus* has circular wing pads and a teardrop-shaped abdomen covered with silvery fine hairs. In addition, the golden-colored western flower thrips is often found on gorse (Fig. 12b).

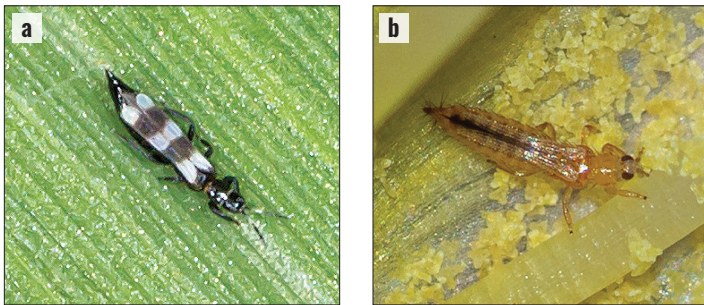


Figure 12. (a) predatory banded thrips (*Aeolothrips fasciatus*) adult; (b) western flower thrips (*Frankliniella occidentalis*) adult (a: iNaturalist.org CC BY 4.0; b: Craig Chaddock, iNaturalist.org CC BY-NC 4.0)

PREFERRED HABITAT

Although the habitat preferences of the gorse thrips are not currently known for the continental USA, the thrips was originally widespread on Hawai'i island, indicating it can tolerate both high and low elevation sites as well as salt spray and high winds. Predation can significantly reduce populations, so ideal habitats are where predator populations are low. Predators include predatory thrips, minute pirate bugs (*Orius* spp.), and likely spiders.

HISTORY AND CURRENT STATUS

Sericothrips staphylinus is native to Western Europe. A population collected from England and Portugal was released in Hawai'i in 1991. A second release was made with individuals from France in 1992. Both release events resulted in successful establishment, and subsequent records do not differentiate between the different source populations. From Hawai'i, thrips were redistributed to the continental USA,

and releases were made in Oregon and California in 2020 and in Washington in 2021.

In Hawai'i, this species is currently established only on Hawai'i Island (Fig. 13). After becoming widespread, populations decreased, possibly due to predation. Even at the highest observed densities, feeding discoloration was only occasionally found on mature gorse plants, but plant death was not observed. Impact in Hawai'i, therefore, has been limited.

In the continental USA, the gorse thrips is believed to be established in at least Oregon and California (Fig. 13). Additional time is needed to confirm establishment in Washington though initial monitoring results are encouraging. **This species is currently not known to be present in Canada.**

NONTARGET EFFECTS

None reported



Figure 13. *Sericothrips staphylinus* reported distribution in the USA (Winston et al. 2021; F. Grevstad, unpub. data)

Tetranychus lintearius Gorse spider mite

Tetranychus lintearius is a biological control agent approved in the USA for release against **common gorse**.

DESCRIPTION

Eggs are tiny, round, and largely transparent. First-instar (larval) mites are light in color and have six legs (Fig. 14a). Second- to fourth-instar (nymphal) mites have eight legs,

are brown, and resemble small adults (Fig. 14a). Adults also have eight legs, are brick red in color, and are up to ½ mm long (Fig. 14a,b).

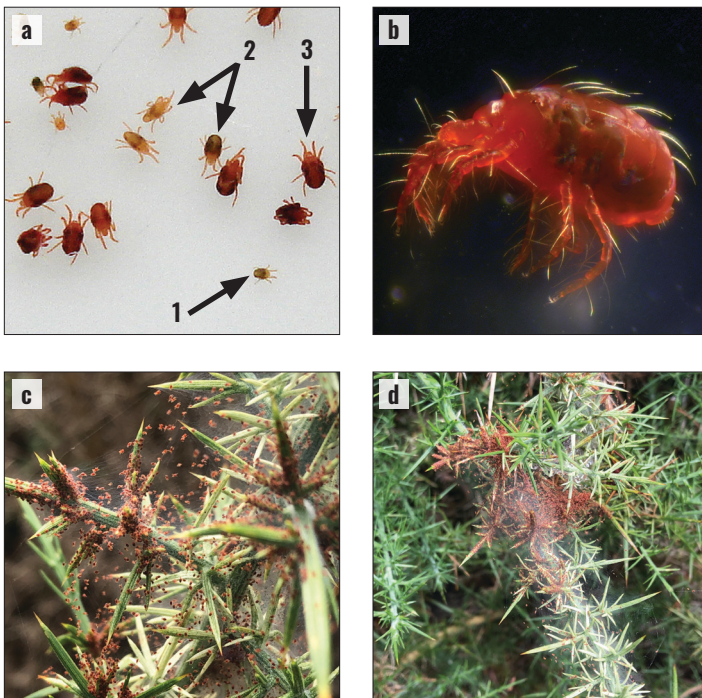


Figure 14. *Tetranychus lintearius* (a) 1st instar (1), 2nd-4th instar (2), adult (3); (b) adult; (c,d) colonies with all stages (a: © Phil Bendle, CC BY-NC-ND 3.0 NZ; b: Tony Wills, iNaturalist.org CC BY-SA 4.0; c,d: Jennifer Andreas, Washington State University Extension)

CLASSIFICATION

RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Animalia	Animals
Phylum	Arthropoda	Arthropods
Class	Arachnida	Arachnids
Subclass	Acari	Mites and ticks
Superorder	Acariformes	
Order	Trombidiformes	
Family	Tetranychidae	Spider mites
Genus	<i>Tetranychus</i>	
Species	<i>Tetranychus lintearius</i> Dufour	Gorse spider mite

LIFE CYCLE

Adults form a colony beneath large amounts of webbing they produce on the terminal branches of gorse. Females lay eggs year-round on infested shoots. Hatching mites complete four immature stages, with larvae and nymphs feeding on plant tissue. Adults feed on stems and spines and live up to four weeks. There are up to six generations per year, and all stages are capable of overwintering.

DAMAGE

Large populations of this mite produce extensive amounts of webbing over mite colonies on gorse terminal branches (Fig. 15a-c). Larval, nymphal, and adult feeding stunts branch growth and reduces flowering (Fig. 15b,c,d), thus contributing to a reduction in the spread of gorse. Heavily infested plants are killed by the extensive feeding (Fig. 15e).

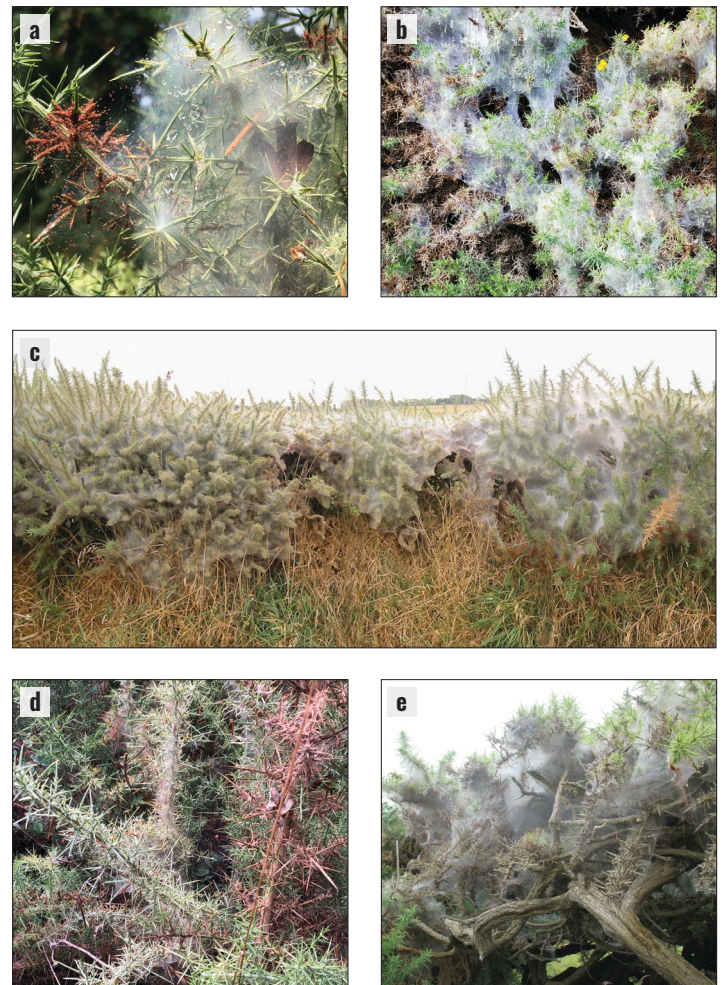


Figure 15. Large colonies of *Tetranychus lintearius* (a-c) feed beneath fine webbing they produce at gorse branch tips. (d,e) stunting branch growth, reducing flowering, and killing heavily infested plants (a,d: Jennifer Andreas, Washington State University Extension; b: Rempson, iNaturalist.org CC BY 4.0; c: Jon Sullivan, iNaturalist.org CC BY 4.0; e: Lloyd Ester, iNaturalist.org CC BY-NC 4.0)

FIELD IDENTIFICATION

Eggs are typically not visible under field conditions because they are so tiny. The webbing of large gorse spider mite colonies (Fig. 15) is the best indication of mite presence. Beneath the webbing, yellowish-brown larvae and nymphs (Fig. 14a) and brick red adults (Fig. 14a-d) can often be seen in large numbers clustered together (Fig. 14d, 15a). Although other gorse biocontrol agents can damage gorse stem tips and reduce flowering (Fig. 3b, 11, 19c), the dense fine webbing differentiates gorse spider mite damage from damage caused by other species.

PREFERRED HABITAT

The gorse spider mite does best in warm, open gorse patches and away from the ocean. Damp oceanside infestations or heavily shaded forest patches are seldom attacked. This mite can be somewhat cold hardy, but severe winter temperatures limit populations.

HISTORY AND CURRENT STATUS

Tetranychus lintearius is native to Europe. Populations from England, Spain, and Portugal were released in New Zealand with the hope that more source populations would increase effectiveness in different habitats. All populations established in New Zealand, became intermixed, and were no longer differentiated. A mixed population from New Zealand was released in California and Oregon, USA in 1994, and in Washington in 1995. After establishment, mites from Oregon were redistributed to Hawai'i, where they established.

This biocontrol agent was initially widely distributed on gorse throughout the western USA, even leading to an 80% reduction in gorse flowering in Oregon. It was most effective in open patches in inland areas. Populations have since decreased significantly due to heavy predation by beetles and predatory mites. Weak webbing indicates predators are likely present. *Tetranychus lintearius* is now considered an ineffective biocontrol agent in the continental USA. **This species is currently not known to be present in Canada.**

In Hawai'i, *Tetranychus lintearius* is established on Maui and Hawai'i Island. It initially provided partial to substantial control of gorse until the year 2000, when predacious mites may have first appeared. Populations of *T. lintearius* are now limited on both islands where it is established (Fig. 16).



Figure 16. *Tetranychus lintearius* reported distribution in North America (Winston et al. 2021)

NONTARGET EFFECTS

None reported

NON-ESTABLISHED SPECIES

Four additional biocontrol agents were released only in Hawai'i, USA; however, all four failed to establish there.

Apion sp. (Coleoptera: Brentidae)

DESCRIPTION AND LIFE CYCLE

The exact identification of this species is unknown, but it is possibly *Apion uliciperda* Pandelle. Not much is known about this species beyond it being closely related and morphologically similar to *Exapion ulicis*, (described in a previous section of this publication). Refer to the description and life cycle of *E. ulicis* for general features. Adults of the unknown *Apion* sp. have been described as being slightly larger and a darker gray compared to *E. ulicis*.

HISTORY AND CURRENT STATUS

After several of the first releases of *E. ulicis* failed to establish in Hawai'i, a species closely related to *E. ulicis* encountered in Spain and Portugal was released on Maui in 1958. This release did not result in successful establishment, and future efforts with this species were abandoned once it was determined that *E. ulicis* had finally successfully established.

Pempelia genistella (Lepidoptera: Pyralidae)

DESCRIPTION AND LIFE CYCLE

Larvae overwinter within a silken feeding web. They become active in spring and feed on gorse spines, leaves, buds, shoots, and flowers beneath their silk web. This feeding causes damaged foliage and stems to turn brown and die. Larvae have green and brown stripes and can be up to 25 mm long. Pupae are dark reddish-brown. Pupation occurs within the silk web in early summer. Adults emerge in summer and lay eggs at the base of mature spines on growing gorse shoots. Adults are light brown with black, brown, and white markings on their wings (Fig. 17); males have a small tuft at the base of antennae. Adults are 10–15 mm long with a wingspan of 26–29 mm. Larvae emerge in late summer to early fall and congregate to spin a coarse creamy-gray silken web with

many tunnels, often at the base of current gorse growth. There are typically 2–9 larvae per web, and overwintering occurs within webs. There is one generation per year.

HISTORY AND CURRENT STATUS

Individuals collected from Portugal were released on Hawai'i Island in 1996. This moth initially established and was recovered in small numbers. Gorse at the release sites was subsequently exterminated by fire and herbicides, and *P. genistella* populations do not appear to have survived.



Figure 17. *Pempelia genistella* adult (Marie Lou Legrand, iNaturalist.org CC BY-NC 4.0)

Stenopterapion scutellare (Coleoptera: Brentidae)

SYNONYMS

Apion scutellare Kirby, *Perapion scutellare* (Kirby)

DESCRIPTION AND LIFE CYCLE

Adults are dark gray with very long, slightly curved snouts and grayish-black legs (Fig. 18). Faint stripes are sometimes apparent on their elytra, and they are typically 4–5 mm long. Adults emerge in spring and deposit eggs into growing gorse shoot tips. Eggs are round, small, and translucent yellow. The shoot continues to grow, but within a month of oviposition, a 1-cm gall forms in which the larva develops by feeding on galled tissue. Galling does not kill attacked shoots, but it halts or significantly reduces their growth. Larvae are cream colored, C-shaped, can reach 5 mm in length, and develop through three instars. Pupae are typically 4 mm long and become dark gray with age. Larvae overwinter in galls. Pupation occurs in galls by late winter/early spring, and new adults emerge in spring. There is one generation per year.

HISTORY AND CURRENT STATUS

Several releases of *Stenopterapion scutellare* were made in Hawai'i from 1961 to 1991 utilizing individuals collected

from Portugal, Spain, and France. All attempts failed for unknown reasons, and this biocontrol agent is not believed to have established.



Figure 18. *Stenopterapion scutellare* adult (Janet Graham, Wikimedia.org CC BY 2.0)

Uromyces pisi f. sp. *europaei* (Pucciniomycetes: Pucciniales)

DESCRIPTION AND LIFE CYCLE

Rust fungi produce up to five spore stages throughout the growing season. In the spring, overwintering spores germinate and infest the stem and spine surfaces of gorse, forming masses of reddish-brown and powdery pustules. Spores spread rapidly from plant to plant as they are easily dispersed by both wind and rain. Multiple cycles may be produced throughout the year. Infected plants can experience stunted growth and reduced seed production.

HISTORY AND CURRENT STATUS

Uromyces pisi f. sp. *europaei* collected from England was released on Hawai'i Island in 2000. A single pustule was observed at the release site two years following release; however, all subsequent surveys have failed to record this biocontrol agent, and it is believed *U. pisi* f. sp. *europaei* did not establish.

UNAPPROVED BIOCONTROL AGENTS

One accidentally introduced species is established on common gorse in North America. **It is illegal to intentionally move this species to new areas in the USA.** Care should be taken when transferring approved agents to ensure that this unapproved species is not also included in transferred material.

Agonopterix nervosa (Lepidoptera: Depressariidae)

DESCRIPTION AND LIFE CYCLE

Adults are 10–15 mm long with variable coloring. Typical adults have white or yellowish wings with small gray to brown mottling, sometimes appearing as stripes on wing veins (Fig. 19a). Their wingspan is 16–22 mm. Overwintering adults emerge during early spring to lay eggs on stems and leaf axils of common gorse, *Scotch broom*, and Portuguese broom. Eggs are yellowish, cylindrical, and 1 mm long. Larvae hatch in late spring. Using plant material and webbing, larvae form tubes on shoot tips of their host plant. Larvae vary in color from yellowish-gray to brown and can be up to 15 mm long (Fig. 19b). They develop through five instars, feeding on young leaves, shoot tips (Fig. 19c), and flower buds (Fig. 19d). The brown pupae are 10–15 mm long. Pupation occurs within the feeding tubes. New adults emerge in late summer and overwinter in their host plant foliage. There is one generation per year.

HISTORY AND CURRENT STATUS

This species was accidentally introduced to North America. It was recorded on common gorse in British Columbia by 1915 and has since been recorded on *Scotch broom* in British Columbia as well. Though its impact on gorse and *Scotch broom* have not been formally studied in Canada, its overall abundance is limited so impact is likely limited as well.

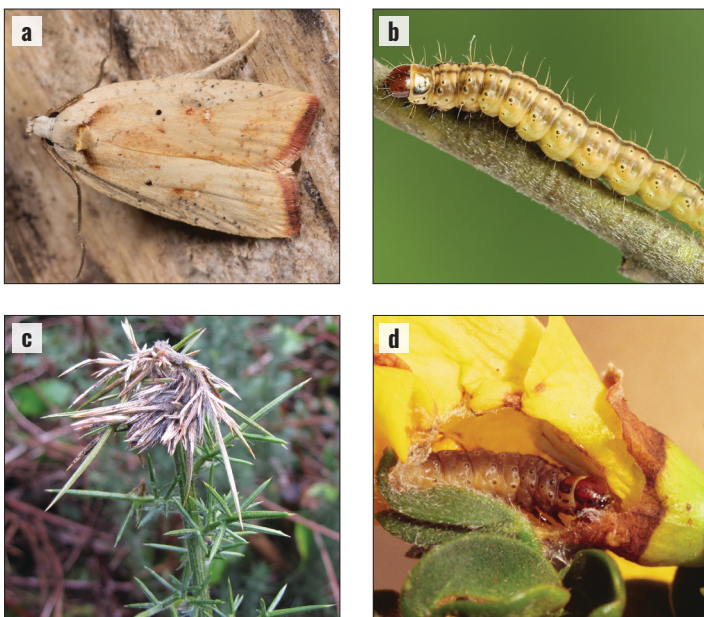


Figure 19. *Agonopterix nervosa*: (a) adult; (b) larva; (c) damage to a gorse shoot tip and spines; (d) damage to a Scotch broom flower (a: Andreas Bennetsen Boe, iNaturalist.org CC BY-NC-ND 4.0; b: Andrey Ponomarev, iNaturalist.org CC BY-NC 4.0; c: Jennifer Andreas, Washington State University Extension; d: Eric Coombs, Oregon Department of Agriculture)

Agonopterix nervosa likely spread from Canada to the USA in the 1920s. It attacks both *Scotch broom* and *gorse* in California, Oregon, and Washington, though it is more abundant on *gorse*. It may stunt shoots and reduce seed production, but overall its impact on both weed species is limited. Populations are heavily parasitized in the USA. This moth also attacks *Portuguese broom* in Oregon. ***Agonopterix nervosa* is not approved for redistribution in the USA.**

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