Longitarsus jacobaeae (Waterhouse) L.

INVASIVE SPECIES ATTACKED: Tansy ragwort (*Senecio jacobaea* L., *Jacobaea vulgaris* Gaertn.)

TYPE OF AGENT: Root feeding flea beetle

COLLECTABILITY: Mass

ORIGIN: Rome, Italy and England

Unless noted otherwise, the information provided on this page relates to the Italian biotype of *L. jacobaeae*.

DESCRIPTION AND LIFE CYCLE

Adult:

Longitarsus jacobaeae are root-feeding flea beetles of tansy ragwort. The adult males are 2-4 mm long while the females are 1 mm larger than the males. Initially golden-tan, they change to golden-brown when mature and finally to dark brown when old. They have enlarged rear legs that enable them to leap great distances. The adults generally emerge in early spring to early summer (May to June), feed for a short time and aestivate until late summer or early fall (September), however spring emergence can be delayed (Powell et al. 1994; P. Harris pers. comm. June 1994.) When they appear later in the season they feed intensely. The shortened days activate sexual changes in both males and females, for example, the flight muscles are absorbed when oviposition begins (Harris undated b). In areas where continuous long days occur, 99% of beetles die before ovipositing. Oviposition is delayed until October when ideal habitat offers 3.5 months of suitable weather. Sites which are too cool will inhibit oviposition (Harris and Crozier 2006). Mating and oviposition continues until sub-zero temperatures arrive, however, if freezing temperatures do not occur, the adults may continue to feed for an additional year (Powell et al. 1994). The flea beetle has historically not been able to control tansy ragwort in Nova Scotia, New Brunswick, Prince Edward Island, B.C. interior and higher elevation sites in Oregon since it starts breeding around the first of October in Canada which allows less than a month compared to the approximate three months on the B.C. lower mainland and 6 months in some areas of Oregon (Harris undated b). However, Italian strain flea-beetles have more recently been found at inland U.S.A. sites at Mt. Hood, Oreg., and Lincoln County, Mont. where the mean annual temperatures are 5.6 and 4.5ºC and mean winter temperatures are -0.76 and -5.13ºC, respectively (Szucs et al. 2011). Each female will lay between 500 to 1000 eggs which are deposited individually at the root crown or base of a leaf petiole or in the soil near the roots. The incubation period takes 2-16 weeks (Harris and Crozier 2006).

Fig. 1. *L. jacobaeae* adult (credit Powell et al.)

After initially feeding, the adults aestivate for the remainder of the summer (Powell et al. 1994). They become most active in the fall when the autumn rains begin (Sheley and Petroff 1999) and breeding commences. Adults choose oviposition locations prior to commencing egg laying (Harris undated b). During the breeding and ovipositing periods, the adults can frequently be found on the soil surface near plants. In mild climates, adults can hibernate during winter months (King County 2004; Washington State University 2013).

Egg:

Eggs are oval and measure 0.66mm x 0.3mm (Harris and Crozier). Initially yellow, they darken during the incubation period (Harris and Crozier).The eggs are vulnerable to desiccation in dry conditions, so long, moist autumns are necessary. Eggs that are laid early will hatch in approximately 30 days, yet those that are laid late can remain until spring (Harris undated a).

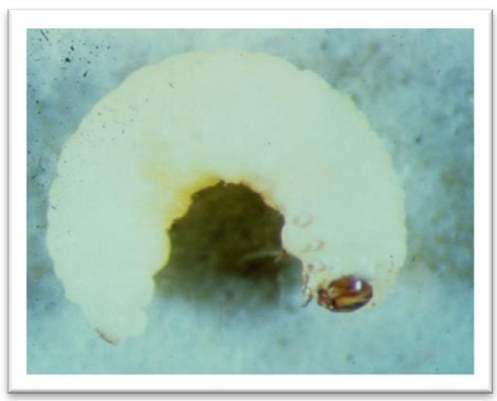

Fig. 2. *L. jacobaeae* larva (credit: Powell et al.)

Larva:

Newly emerged larvae are yellow and the mature instars are white (Harris and Crozier). The head capsules are dark brown and the thoracic shields and anal plates are brown (Powell et al. 1994; Harris and Crozier 2006). The slender, comma-shaped larvae measure 6.5mm long x 1.0mm wide (Harris and Crozier). The larvae initially begin to feed on the root crown (Coombs). Development continues on the cork-like outer layers of the root crown, in the lateral roots and in the interior and exterior root parts (King County 2004; Washington State University 2013). Long grooved formations within the roots are the result of feeding on the outer layers (Wilkinson 1986). In crowded or waterlogged conditions, the larvae will feed on root crowns and within the petioles of lower leaves (Harris and Crozier 2006).

Pupa:
The pupae are white and 2-4 mm long (Rees et al. 1996). Mature larvae will move to the soil to pupate, doing so up to 5cm from the plant (Wilkinson 1986).

Overwintering stage:
Mature larvae typically overwinter in plant roots and will move to the soil to pupate the following June, doing so up to 5 cm from the plant (Wilkinson 1986). The agent can also spend the winter months as eggs (Harris and Crozier 2006).

EFFECTIVENESS ON HOST PLANT

Many consider *L. jacobaeae* to be the most effective biocontrol agent for reducing tansy ragwort stand densities, including in low density infestations and near the coast (Sheley and Petroff 1999). The flea beetles' population has been shown to rapidly increase and crash in response to their host plant's increase following disturbance and rapid decline following the bioagent's attack. *L. jacobaeae* has a strong ability to search out and colonize tansy ragwort infestations. The flea beetle is also able to attack many of the plant's parts, stages and in various seasons, conditions (tolerates some shade and soil moisture) and plant densities (McEvoy and Rudd 1993). Adult ragged shot-hole feeding (5mm diameter holes) typically causes little impact to the plant however, in large quantities, heavy adult feeding can kill rosettes in the fall and winter months (Harris undated a; P. Harris, A.T.S Wilkinson and J. H. Myers, unpublished data, undated, Canada; King County 2004). Washington State University (2013) notes that adult feeding restricts photosynthesis and the plant's ability to store nutrients. Larvae preferentially feed on and can kill small rosettes (Harris and Crozier 2006). Density of larvae found at early B.C. release sites was 5-13 larvae/rosette on 95% of the rosettes sampled which led to significant reductions in tansy ragwort biomass (CABI 1988). Root feeding impacts the plant's stored energy reserves necessary to survive the winter. Some reports say the larvae feeding during the winter on rosette roots can cause the rosettes to die when they begin to bolt the following spring while others claim the combined efforts of adult and larvae feeding can kill plants by the time they would typically be producing new vegetative shoots and buds (King County 2004; Washington State University 2013). In general, it has been noted that the effectiveness of biocontrol may take up to six years before a significant change in plant density can be observed, for example, tansy ragwort plants may continue to survive but remain as a rosette for several years if they are damaged, nutritionally impoverished or subjected to strong competition (King County 2004; Thompson and Harris 1986). However, McEvoy and Rudd (1993) demonstrated that *L. jacobaeae* rapidly reduced tansy ragwort's ability to survive which led to a sharp decline in plant abundance in a five year field study. *L. jacobaeae* feeding can indirectly affect seed production; however, this is more efficient when coupled with *B. seneciella* or *T. jacobaeae* (in particular) feeding. Buried seed is not affected and the plant population may resurge if the number of flea-beetles decreases as a result of lack of food. *L. jacobaeae* can survive on few plants (unlike *T. jacobaeae*) and remain in an infestation, their numbers rising again when the flea beetle adeptly finds new plants as the plant population increases (Harris and Crozier 2006; Corvallis Oregon newsletter 1988). However, if the flea-beetle population is no longer present due to lack of food, the agent may need to be re-introduced into the area.

Fig. 3. *L. jacobaeae* adult pin hole feeding evidence on tansy ragwort leaves

Fig. 4. *L. jacobaeae* larva feeding evidence on tansy ragwort root

Fig. 5. *L. jacobaeae* dispersal area near Nanaimo (Coastal Douglas-Fir zone)

HABITAT AND DISTRIBUTION

Native:

L. jacobaeae has a native distribution extending from Ireland to Siberia and Tibet (Harris, Wilkinson and Myers). It is common to areas in central Italy, Sardinia, south Scandinavia, and from Ireland to east Georgia. In Western Europe, it is limited to latitudes between 40-57°N and further restricted in the Ukraine to south of 50° (Harris and Crozier).

Fig. 6. Established *L. jacobaeae* release site near Chemainus (Coastal Douglas-fir zone)

North America:

L. jacobaeae was first introduced to the U.S.A. and releases began in 1968. Establishment has occurred throughout infestations in Calif., Mont., Oreg. and Wash (Winston). Coombs et al. reported in 1996 that in the Pacific Northwest, *L. jacobaeae* has not established east of the Cascade Mountains (Coombs/Rees). In 1971, the first Canadian releases were made in B.C. (Harris, Wilkinson and Myers.) the province continued to receive release shipments until 1976 (Harris, Wilkinson and Myers). Releases were subsequently made in N. B. (1981) and P.E.I. (1978 and 1981). The two releases made in P.E.I. were found in 1982 and in 1983 to have established in low numbers (Harris, Wilkinson and Myers). Establishment of initial releases made in the Canadian Maritime provinces was poor (Harris and Crozier). By 2006, *L. jacobaeae* was considered established in B.C., N.B., N.S., and P.E.I. (Harris and Crozier).

L. jacobaeae requires sunny locations with high density plants growing in well-drained soils. It does not tolerate flooding, heavy shade, or elevations over 400m (Harris and Crozier). Areas with long, moist autumns are required (Harris and Crozier).

Fig. 7. Non-established *L. jacobaeae* release site near Naramata (Interior Douglas-fir

British Columbia:

L. jacobaeae has been released into the Coastal Douglas-fir, Coastal western-hemlock and Interior Douglas-fir biogeoclimatic zones. Establishment is restricted to the lower mainland and coastal environment in the Coastal Douglas-fir and Coastal western-hemlock zones, remaining unsuccessful in the south Okanagan Interior Douglas-fir zone. Dispersal throughout the Coastal Region is wide spread.

BRITISH COLUMBIA RECORD

Origin:

The *L. jacobaeae* populations released in B.C. originated from Italy via established field populations collected in Calif. and Oreg. Later, in 1972, a small population was imported from England (Winston).

History:

The first *L. jacobaeae* population brought to B.C. in 1971 was divided for: lab rearing at UBC; and into an open release in Abbotsford (Harris, Wilkinson and Myers). The subsequent population imported from England (1972) was released on Vancouver Island near Nanaimo. Additional adults were shipped from the U.S.A. field sites in 1976 and released directly into the Nanaimo field sites (Winston). These early releases made near Nanaimo are, therefore, comprised of populations from England and Italy via Oreg., U.S.A. - it was subsequently determined that 10% of the population received from Oreg. included a very closely related flea-beetle species *Longitarsus flavicornis*, which had presumably been mixed in the population received by the U.S.A from Italy. In 1976, the first field collections in B.C. commenced and flea-beetles were released in the Coastal Forest Region. It is suspected that collections taken from these sites and redistributed to new sites in B.C. and other provinces are likely mixed (Winston). However, no *L. flavicornis* were subsequently recovered at sites that were populated with flea beetles collected from Nanaimo and none have been found in Nanaimo in recent years. Between 1992 and 2001, four unsuccessful attempts were made to establish the Italian strain of *L. jacobaeae* in the Okanagan. Assisted redistribution efforts continue into more suitable habitat areas that the agent may not easily reach due to large gaps in infestation corridors.

Fig. 9. *L. jacobaeae* dispersal location in Abbotsford (Coastal western hemlock zone)

Field results:

L. jacobaeae has been widely released in the Fraser Valley, in the lower mainland and on Vancouver and Gulf Islands. The most easterly release was made near Seabird Island in 1996. It established and is self-dispersing westward to within 21 km of the Fraser Valley tansy ragwort infestations as of 2012. It has dispersed as far east as Agassiz (Bridal Falls) but, again as of 2012, no evidence has been found at any of the tansy ragwort infestations established in the immediate Hope area (the furthest east of the coastal infestations). It is established and dispersing on Vancouver Island and various Gulf Islands in the general areas of the releases including Nanaimo, Cedar, Cassidy, Duncan, and, Gabriola, Salt Spring, and Mudge Islands. At the 1974 release near Nanaimo, monitoring results in 1976 found 14 beetles / hour (Harris, Wilkinson and Myers). A supplemental population was added to the site in 1976 and in 1981, 97% of all plants sampled were attacked and had an average of five larvae / plant (Harris, Wilkinson and Myers).

The adults are more easily observed when tansy ragwort plants are growing in areas with less plant competition or where the competing vegetation is grazed. Adults are rarely found on the upper half of bolted plants, but instead are frequently observed on the upper and lower leaf surfaces of large rosette or basil leaves during the spring and summer months. In coastal habitats, adults, larvae, and foliar feeding can be observed at low levels by early August. In the Fraser Valley, overwintered adults have been observed on plants in April.

Fig. 7. Photo taken in 1990 at established *L. jacobaeae* release site near Nanaimo photo (Coastal Douglas-fir zone)

Fig. 8. Photo updated in 1997 of same established *L. jacobaeae* release site near Nanaimo

Collection for redistribution:

L. jacobaeae are collected for redistribution as adults. As the adult flea beetles aestivate during the summer months, they appear more abundant and are less prone to disperse as they mate and oviposit in the fall. The optimal handling months occur between late September and late November. It has been found that it is more difficult to monitor for and collect adults in thick, competing vegetation. Check for feeding evidence to determine their presence. The shot holes will be visible mainly on the lower leaves. Collect the flea beetles by aspirating them from the plants with hand-held aspirators or large units carried on the back. With this method, collection can take place any time of day. Once an area has been passed over, wait approximately 30 minutes and re-visit the area again as those flea-beetles that fled the disturbance will readily return to the plants. When aspirating the flea-beetles with large backpack aspirators, plant and other debris also gets sucked up. Place all contents into a large plastic bag to allow the flea-beetles to emerge from the debris. Separate the flea-beetles from the debris, which may contain a variety of unwanted invasive plant seeds and predators such as spiders, by using a hand-held aspirator. Transfer the flea-beetles to containers for transport. If large numbers of flea-beetles are placed into a container, add fluffed up tissue to create surface area upon which the beetles can cling and disperse themselves from one another to prevent constant contact and disturbance from other jumping flea-beetles.

It is recommended to release a minimum of 150 flea beetles (preferably more) to a new site with the same habitat and approximately 1000-2000 to a different habitat type. In Montana U.S.A., 100 to 500 are recommended (Rees et al. 1996). In any case, it is always preferable for the agents to be collected and redistributed within the same type of habitat. If the recipient site is within a different habitat/BEC zone, it is advisable to use larger numbers to transfer to compensate for the stress on the population as much as possible. Releasing two or more biocontrol agents that attack tansy ragwort plants via different modes and during varying times of the year, can increase their efficacy than if released alone (McLaren et al. 2000).

NOTES

- Multiple agents are always recommended for control of tansy ragwort. To date, the most significant effect on tansy ragwort in B.C. has been as a result of *T. jacobaeae* and *L. jacobaeae*.

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