

has also established in South America, Australia, and New Zealand. Widely established in temperate regions, it is not found in the tropics (Lemna and Messersmith 1990).

Habitat: While it is adapted to many soil types, perennial soil thistle seems to prefer low, fine-textured soils, especially loams. The plant does better under alkaline or neutral conditions than under acidic conditions. Perennial sowthistle is commonly found in cultivated fields (both grain and row crops), waste areas, meadows, sloughs, woods, lawns, roadsides, beaches, ditches and river and lake shores (Lemna and Messersmith 1990).

History: A native of Eurasia, perennial sowthistle has spread to many parts of the world via seeds and roots (Gaines and Swan 1972). It was probably introduced to North America via contaminated commercial seed (Dennis 1980; Lemna and Messersmith 1990). The North American sighting of the species was from Pennsylvania in 1814.

Growth and Development: As the name indicates, perennial sowthistle is a perennial plant. In established stands, shoots and new roots begin to form around April, when the soil warms. The shoots develop from buds that overwinter on roots or the basal portion of aerial stems. Seeds also germinate around the same time period. Plants form rosettes early in development, which provide a large photosynthetic area. The species can spread rapidly via its spreading root system. Most plants do not flower during the first-year, but seedling growing under favorable conditions have been known to produce flowers in some areas (Lemna and Messersmith 1990).

Reproduction: Perennial sowthistle reproduces by seeds and creeping roots (Muenscher 1955). Its root system allows the plant to quickly establish in new areas and to persist under cultivation. Seed production is highly variable, but a typical head produces roughly 30 seeds, which are generally dispersed by wind. However, the hairs (pappus) on the end of the seeds have hooked cells that allow them to stick to clothes, fur, vehicles, and farm implements. The seeds are also sometimes moved as commercial seed or hay contaminants (Lemna and Messersmith 1990).

Response to Herbicides: Herbicide control of perennial sowthistle when combined with other control methods because the species is relatively resistant to many common broadleaf herbicides. Most chemical control recommendations for perennial sowthistle are for auxin-type herbicides. Amitrole, dicamba, MCPA amine, and 2,4-D amine have all been recommended for control at various growth stages (see Lemna and Messersmith 1990 for more details). Less information exists for non-auxin herbicides. Pre-harvest treatments of glyphosate have been successful in Britain, but fall applications were generally less effective than auxin-based herbicides. The species has also been shown to be susceptible to atrazine, simazine, bromacil, monuron, and diuron, as well as some sulfonyleurea herbicides (Lemna and Messersmith 1990).

Response to Mechanical Methods: Depending on the timing and type, tillage can reduce perennial sowthistle stands. Some existing evidence suggests that mowing would not be as effective as tillage as a control method. Tillage at the 7- to 9-leaf rosette stage seems to work best for reducing the reproductive capacity of the roots. Depth of burial and amount of root breakage determine the effectiveness of tillage. Root fragments left on the soil surface die from desiccation, and those buried 30 cm or more are unlikely to resprout. However, roots buried at intermediate depths will

produce new shoots. Smaller root fragments produce fewer, less vigorous shoots (Lemna and Messersmith 1990).

Biocontrol Potentials:

Domestic animals - Since perennial sowthistle is palatable to both sheep and cattle, pasturing infested land can be an effective control method (Lemna and Messersmith 1990).

Insects - In Europe, 53 insects are known to feed on perennial sowthistle. However, only six of these species are restricted to the genus *Sonchus*; this group includes four species that are endophytic in flower heads, one species external on stems and leaves, and one species endophytic on leaves. In Canada, three insects have been investigated for biocontrol of perennial sowthistle: *Tephritis dilacerata* Loew (Diptera: Tephritidae), *Liriomyza sonchi* Hendel (Diptera: Agromyzidae), and *Cystiphora sonchi* Bremi (Diptera: Cecidomyiidae) (Peschken et al. 1989). Infestations of *C. sonchi* in Canada have produced no observable reductions in weed population sizes (Lemna and Messersmith 1990). No insect biocontrol agents are presently available for perennial sowthistle in Washington.

Nematodes - Perennial sowthistle is susceptible to at least three species of nematode: *Meloidogyne incognita* (root-knot nematode), *Heterodera sonchophila* (cyst-forming nematode), and *Pratylenchus penetrans* (lesion-forming nematode). *P. penetrans* is pathogenic to several crops, but *H. sonchophila* is considered a specialized parasite that has been highly pathogenic to perennial sowthistle seedlings in Estonia (Lemna and Messersmith 1990).

Microorganisms - The plant is also susceptible to several fungi, viruses, and bacteria. Unfortunately, many of these pathogens cause disease in economically important crops, as well. However, three species of fungi (*Marssonina sonchi*, *Septoria sonchi-arvensis*, and *Septoria sonchifolia*) are apparently specific to perennial sowthistle in Canada (Lemna and Messersmith 1990).

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