The biology and non-chemical control of Smooth Sow-thistle (*Sonchus oleraceus* L.)

W Bond, G Davies, R Turner
HDRA, Ryton Organic Gardens, Coventry, CV8, 3LG, UK

Smooth sow-thistle

(annual sow-thistle, common sow-thistle, dindle, hare's colewort, hare's lettuce, milk-thistle, milkweed, milky dashel, milky dickles, sow-dingle, sow-thistle, swine thistle)
***Sonchus oleraceus* L.**

Occurrence

Smooth sow-thistle is a native summer or winter annual found throughout the UK (Clapham *et al*., 1987). It is abundant in lowland Britain on waste and cultivated ground, roadsides and on arable land on most soils (Stace, 1997). It is a common garden weed (Copson & Roberts, 1991). Smooth sow-thistle prefers open ground and likes nutrient-rich soils that are not too dry (Hanf, 1970). It is largely absent from acidic sites (Grime *et al.*, 1988). Smooth sow-thistle has a broad tolerance of climatic variation but is not recorded above 1,250 ft in Britain (Salisbury, 1961). It is a pioneer species that establishes in disturbed areas (Weber, 2003). Bare soil exposed by rabbits or opened up by burning, felling or other human activity offers favourable conditions for smooth sow-thistle to develop (Lewin, 1948). It is considered invasive because it grows in dense patches that crowd out other plants but is shade intolerant itself. It is more abundant than prickly sow-thistle (*S. asper*) (Salisbury, 1962).

Smooth sow-thistle shows considerable variation in leaf form (Hutchinson *et al*., 1984). A number of ecotypes and varieties occur differing in leaf shape and flower colour (Lewin, 1948). Light levels in the habitat influence stem and leaf colour. In hedgerows the plants are green, in open ground they have a reddish hue.

Smooth sow-thistle is a host of various aphids including the currant and lettuce aphis (Morse & Palmer, 1925). It acts as a reservoir for several important plant viruses including beet western yellows (Hutchinson *et al.*, 1984). It is also a host of certain nematodes.

Sow-thistles have been used as potherbs since ancient times (Lewin, 1948). Smoot sow-thistle also has herbal uses for treating fevers and high blood pressure (Mitich, 1988).

Biology

Smooth sow-thistle flowers mainly from June to August (Clapham *et al*., 1987). Plants that overwinter as a rosette may start to flower in late-April (Lewin, 1948). Flowering often ends in October or with the first frosts (Hanf, 1970). Flowers are self-compatible and probably self-fertilized. Mature seeds are formed 1 week after flowering in summer but may take longer in cooler conditions. Plants cut in bud do not ripen viable seed but seed from plants cut in flower had germination levels of 100% (Gill, 1938). The average number of seeds per flower head is estimated at 140 and the mean number of flower heads per plant is 44. Seed production per plant is given as 6,100, much less than for the prickly sow-thistle. However, others have estimated seed production at an average of 40,000 seeds per plant (Salisbury, 1962)

and 5,000 to 25,000 seeds per plant (Guyot *et al.,* 1962). Smooth sow-thistle can be found in fruit 5 months of the year. The time from germination to fruiting is around 100 days.

In Petri dish tests with seed maintained under high or low light intensity or in darkness, seed gave around 60% germination in the light and 28% in the dark (Grime & Jarvis, 1976). The estimated base temperatures for germination ranged from 5.27 to 6.84°C indicating that it is adapted to being a winter annual (Steinmaus *et al.*, 2000). In laboratory tests, seed in the light germinated up to 21% at a constant 18-20°C, up to 58% at alternating 20 to 30°C and up to 89% with cycles of 20 to 30 to 8°C (Cross, 1930-33). Seed that was tested after it had been stratified in soil overwinter gave almost complete germination in the light or in darkness with just a 5 second light flash (Andersson *et al.*, 1997). In complete darkness 61 to 81% of seeds germinated

Seeds collected and sown the same day, emerged mainly in the first month after sowing and then intermittently in the months that followed. Seed germinated 14 days after sowing in May (Long, 1938). Seeds may require light for germination under certain conditions and this may restrict germination in tall vegetation (Hutchinson *et al.*, 1984). Germination is shallow, on the soil surface or within 20 mm (Hanf, 1970). Seed sown on the surface of trays of soil gave 77% emergence while seed sown at 30 mm deep gave just 5% seedling emergence (Sheldon, 1974). Seed sown in a 75 mm layer of soil in cylinders sunk in the field and stirred periodically, emerged from April to September with the main flush from April to June (Roberts & Neilson, 1981). Most seedlings emerged in year 1 of the 5-year trial and emergence then reduced fairly rapidly to year 5, leaving very few viable seeds remaining after that time.

Germination and seedling establishment is better in conditions of high humidity (Sheldon, 1974). In dry conditions the seed's hairy pappus holds the seed above the soil surface. In moist or humid conditions the pappus collapses permanently and the seed lays on the soil surface. The position of the seed on a substrate has a significant effect on the level of germination. Seeds germinate best (60-80%) when upright or at an angle of 45° with the scar of attachment partially buried and when the seed is laying flat on the soil surface or buried at 5 mm. Germination is moderate (30-40%) when seeds are laid on edge on the soil surface. Seeds that are partially-buried and vertical with the scar of attachment uppermost germinate poorly (20%). There is no germination when seeds that are vertical with the scar of attachment uppermost are not buried at all.

In short days, the plant forms a rosette, a flower stem develops only at longer daylengths (Lewin, 1948). Seedlings that emerge in spring reach the rosette stage after around 6 weeks, then stem elongation occurs and flower buds form (Hutchinson *et al*., 1984). Winter rosettes can withstand several degrees of frost (Lewin, 1948). Plants usually have a single stout taproot (Frankton & Mulligan, 1970).

Persistence and Spread

Seed recovered from excavations and dated at 150 years old was found to germinate (Ødum, 1974). Dry-stored seed, both ripe and unripe when collected, remained viable for about 10 years (Lewin, 1948). The half-life of seed in cultivated soil, however, may be just 1 year (Hutchinson *et al*., 1984).

Seeds have a pappus of hairs (Frankton & Mulligan, 1970). The seed is wind dispersed (Long, 1938). Laboratory tests suggest maximum seed dispersal distances of 4.4 and 6.6 metres at wind speeds of 10.9 and 16.4 km/hour respectively but this would be affected by plant height (Sheldon & Burrows, 1973). The hairy pappus attached to the seed collapses under conditions of high humidity limiting dispersal in damp conditions (Hutchinson *et al*., 1984).

Smooth sow-thistle seed occurs as a contaminant in seeds of clover, lucerne, oats and Italian ryegrass. The seeds form a part of the diet of several birds (Hutchinson *et al*., 1984). Seedlings have been recorded from bird droppings (Salisbury, 1962). In the USA, seed has been recovered from irrigation water (Kelley & Bruns, 1975). The seeds float for 3 days or more in water (Lewin, 1948).

Management

Standard cultivations and the hoeing of root crops are usually sufficient to deal with the weed (Morse & Palmer, 1925). Surface cultivations in spring and the inclusion of root crops should keep smooth sow-thistle in check (Long, 1938). Seeding should be prevented by hoeing or hand pulling the young plants, or by cutting off the flower stems. Topping the plants in flower may result in the production of further flower stems. Tillage during the main emergence period in spring will help to control the weed (Hutchinson *et al*., 1984). Regular cultivations will stimulate further germination and reduce seed numbers in the soil seedbank. Plants do not regenerate from root fragments (Weber, 2003).

Smooth sow-thistle is favoured by non-tillage systems, in both the long and short term, due to the wind dispersal of its seeds (Tuesca *et al.*, 2001).

Smooth sow-thistle seed is susceptible to soil solarization.

Smooth sow-thistle does not survive beyond the seedling stage if it is shaded to any great extent (Lewin, 1948). It cannot withstand repeated trampling but can recover if this happens at early growth stages. Smooth sow-thistle may be controlled by sheep grazing or by mowing. Smooth sow-thistle is browsed by rabbits and hares (Barker, 2001). A range of insects, fungi and bacteria attack the plant (Lewin, 1948).

Acknowledgement

This review was compiled as part of the Organic Weed Management Project, OF 0315, funded by DEFRA.

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