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

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Prickly sow-thistle

(spiny annual sow-thistle, spiny-leaved sow-thistle, spiny milk-thistle, spiny sow-thistle)
***Sonchus asper* L.**

Occurrence

Prickly sow-thistle is a troublesome winter or summer annual, common on arable land (Long, 1938). It is native in cultivated and waste places (Clapham *et al.*, 1987) and common in gardens and on roadsides (Hutchinson *et al.*, 1984; Copson & Roberts, 1991). It grows on a range of soils but prefers well drained slightly acid to alkaline soils, and has some tolerance to saline conditions. It also has a broad tolerance of climatic conditions. Prickly sow-thistle is recorded up to 1,500 ft (Salisbury, 1961) and is abundant in lowland Britain (Stace, 1997). It is generally less abundant than smooth sow-thistle (*S. oleraceus*) (Salisbury, 1962).

In a study of seedbanks in some arable soils in the English midlands sampled in 1972-1973, prickly sow-thistle was recorded in 53% of the fields sampled in Oxfordshire and in Warwickshire (Roberts & Chancellor, 1986). Prickly sow-thistle seed was found in less than 1.5% of arable soils in a seedbank survey in Scotland in 1972-1978 (Warwick, 1984). In seedbank studies in arable fields in France, prickly sow-thistle was well represented in the seedbank and in the emerged vegetation (Barralis & Chadoeuf, 1987).

A number of varieties and ecotypes have been described but growth habit, pigmentation, spininess and leaf form are largely controlled by environmental conditions (Lewin, 1948). Biotypes with resistance to the sulfonylurea herbicide, metsulfuron-methyl, have been recorded in Canada (Rashid *et al.*, 2003). In the absence of the herbicide, the resistant forms exhibit no difference in competitive ability compared with the susceptible forms.

Sow-thistles have been used as potherbs since ancient times (Lewin, 1948). Prickly sow-thistle is host to various aphids and acts as a reservoir for several important plant viruses including beet western yellows (Hutchinson *et al.*, 1984).

Biology

Prickly sow-thistle flowers from from June to October (Hanf, 1970). The flowers are self-compatible. Mature achenes are formed 1 week after flowering. The average number of seeds per flower head is 198, and the average number of flower heads per plant is 105. Seed number per plant is around 4,700. Other estimates of the average seed number per plant range from 21,500 to 25,000 but a large plant may have 60,000 seeds (Salisbury, 1961). In cereal crops the average seed number per plant ranged from 476 to 512 and in root crops from 1,262 to 1,859 (Pawlowski, 1966). Seed numbers per plant may be reduced to 512 in winter cereals and 5,800 in a row crop

(Clarke *et al.*, 1995). Moisture stress reduces seed production. Prickly sow-thistle can be found in fruit for 3 months of the year.

In Petri dish tests with seeds maintained under high or low light intensity or in darkness, germination was virtually complete in the light but only 4% of seeds germinated in the dark (Grime & Jarvis, 1976). A period of dry-storage increases seed germination (Grime *et al.*, 1988). Seeds may germinate within 2 weeks of sowing (Salisbury, 1962). Light and stratification at 6^{o}C stimulate seed germination. Seed that was tested after it had been stratified in soil overwinter gave almost complete germination in the light, in darkness with just a 5 second light flash and in complete darkness (Andersson *et al.*, 1997).

Seeds on the soil surface germinate better than those buried at 30 mm deep. Seeds germinate from spring to autumn (Hutchinson *et al.*, 1984). Spring emerging seedlings reach the rosette stage after 6 weeks. This is followed by stem elongation and bud formation. Seed sown in a 75 mm layer of soil in cylinders sunk in the field and stirred at intervals, emerged from March to July with the main flush from March to April and odd seedlings emerging at other times (Roberts & Neilson, 1981). Seedling emergence in field plots cultivated at monthly, 3 monthly, or yearly intervals or not at all extended from March to November with a peak in August-November (Chancellor, 1964). Seedling numbers were higher in the least cultivated plots.

Seed rain from plants that emerged following cultivations made in April extended from mid-July to November (Leguizamón & Roberts, 1982). Seed numbers in the upper 10 cm layer of soil increased from an initial 90 to a final 1,060 per m^2.

Plants develop a strong taproot (Frankton & Mulligan, 1970).

Persistence and Spread

The half-life of seeds in dry storage is 2-3 years and in cultivated soil is just 1 year (Hutchinson *et al.*, 1984).

Seeds have a pappus of hairs (Frankton & Mulligan, 1970). The seeds are wind dispersed (Long, 1938). Aircraft flying at 2,000 ft have collected sow-thistle seeds (Lewin, 1948). In damp conditions the pappus collapses and dispersal ceases (Hutchinson *et al.*, 1984). The seeds can be carried on clothes and fur (Woodruffe-Peacock, 1909). When seed was ingested by earthworms, a high proportion was recovered in the worm casts (McRill, 1974). The seeds are eaten by birds and viable seeds may occur in their droppings. Viable seeds have been found in cow manure (Hutchinson et al., 1984). Seeds that had passed through the digestive system of a cow retained 27% viability (Lewin, 1948). In the USA, prickly sow-thistle seed has been recovered from irrigation water (Kelley & Bruns, 1975).

In a survey of weed seed contamination in cereal seed in drills ready for sowing on farm in spring 1970, prickly sow-thistle seed was found in 5% of samples (Tonkin & Phillipson, 1973). Most of this was home saved cereal. In cereal seed sampled in the period 1978 to 1981, prickly sow-thistle seed was found in up to 1% of wheat and up to 5% of barley samples tested (Tonkin, 1982). In a survey of grass seed contamination in 1960-61, prickly sow-thistle seed was found in 2.8, 1.5 and 2.7% of samples tested of perennial ryegrass and in 5.1, 1.4 and 2.5% of Italian ryegrass

samples tested of English, Irish and Danish origin respectively (Gooch, 1963). It was also found in 9.0% of Timothy, 1.6% of cocksfoot and red fescue and 1.7 of meadow fescue samples tested, all of English origin. In rough-stalked meadow-grass of Danish origin it was found in 28.6% of samples tested. In clover and grass seed samples tested in Denmark for the period 1966-69, 1955-57, 1939 and 1927-28, prickly sow-thistle seed was a contaminant in 3.4, 3.7, 6.0 and 3.9% of samples respectively (Olesen & Jensen, 1969).

Management

Seeding should be prevented by hoeing or hand-weeding and by cutting off the flowering stems (Long, 1938). However, plants cut down early to prevent seeding may produce further flower stalks. The inclusion of root crops in the rotation should help to keep the weed down. Tillage during the spring emergence period will keep the weed in check and regular cultivations will help to deplete the soil seedbank (Hutchinson *et al.*, 1984).

In pasture, prickly sow-thistle may be controlled by grazing with sheep or by mowing (Lewin, 1948).

In a 2-year set-aside in Scotland, prickly sow-thistle seed numbers in the soil increased when the set-aside was left fallow but not when there was a sown grass cover (Lawson *et al.,* 1992). In set-aside over a 3-year period, a sown cover of ryegrass or ryegrass/clover had a lower population of prickly sowthistle than natural regeneration (Boag *et al.,* 1994). With the natural cover, prickly sowthistle numbers increased both in the seedbank and as growing plants. Seed numbers were greater where the cover was cut once a year rather than twice.

In a study of the effect of heat on seed viability, imbibed seeds in trays of moist soil held at 75 or 100^{o}C lost viability after 12 hours but at 56^{o}C the results were variable and seed viability was reduced by around 76-82% after 0.5-16 days (Thompson *et al.*, 1997). Seed held at 155^{o}C for 7.5 minutes or at 204 or 262^{o}C for 5 minutes was killed. Prickly sow-thistle seed is susceptible to soil solarization.

A range of insects, fungi and bacteria attack the plant (Lewin, 1948).

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