The biology and non-chemical control of Sheep's Sorrel (*Rumex acetosella* L.)

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Sheep's sorrel

(cuckoo's sorrel, red sorrel, sour dock, sour grass)
***Rumex acetosella* L.**

Occurrence

Sheep's sorrel is a perennial plant native in open ground, short grassland and cultivated land mostly on acid, sandy soils throughout Britain (Stace, 1997). It is infrequent on calcareous soils (Clapham *et al.*, 1987). Sheep's sorrel may sometimes be a troublesome weed in dry pastures and is considered to be an indicator of poor, sour, sandy soils and the absence of lime (Long, 1938). In early surveys of Bedfordshire, Hertfordshire and Norfolk it was characteristic of acid sandy soils and light sandy loams but was never associated with chalk (Brenchley, 1911; 1913). Sheep's sorrel occurs both in permanent grassland and in disturbed habitats such as arable land and burnt moorland, particularly on acid or peaty soils (Putwain, 1970). It is a hater of lime and seedlings become chlorotic on calcareous soils (Morse & Palmer, 1925, Grime *et al.*, 1988).

There is evidence that sheep's sorrel was a weed of crops in the Bronze Age (Greig, 1988). It is frequent on both grazed and ungrazed grassland and heathland but the plant itself is little grazed (Grime *et al.*, 1988). It has been found as often among one arable crop as another (Brenchley, 1920). Sheep's sorrel seed was found in 2.3% of arable soils in a seedbank survey in Scotland in 1972-1978 (Warwick, 1984). In a seedbank survey in swede-turnip fields in Scotland in 1982, it was found in 24% of the fields sampled (Lawson *et al.*, 1982). In a comparison of the ranking of arable weed species in unsprayed crop edges in the Netherlands in 1956 and 1993, sheep's sorrel moved from 17th to 23rd place (Joenje & Kleijn, 1994).

It is a very variable species and forms large stands by vegetative growth (Weber, 2003). It occurs occasionally as a birdseed alien (Hanson & Mason, 1985).

Sheep's sorrel has been found to be injurious to horses and sheep but is little grazed and rarely fatal (Morse & Palmer, 1925). In cattle, poisoning can occur when sheep's sorrel is eaten in large quantities due to the oxalate content (Lee & Doyle, 1940). In cattle and sheep it causes calcium deficiency that gives symptoms similar to milk fever (Forsyth, 1968). Sheep's sorrel has medicinal and therapeutic uses but the plant may accumulate nitrates at unacceptable levels (Barker, 2001). Sheep's sorrel also accumulates phosphorus (Salisbury, 1962). It can carry economically important viruses some of which are seed borne (Heathcote, 1970).

The seeds of sheep's sorrel are defined as injurious weed seeds in the 1951 Regulations made under the Seeds Act, 1920 (Chancellor, 1959).

Biology

Sheep's sorrel flowers from May to September (Lousley & Kent, 1981) or May to August (Clapham *et al*., 1987). Male and female flowers are found on separate plants (Frankton & Mulligan, 1970). The male flowers tend to be produced earlier than the female ones (Grime *et al.,* 1988). The ultimately taller female inflorescences continue to elongate and develop after the male inflorescences have matured (Putwain & Harper, 1972). The flowers are wind pollinated. Seed is set from July to October. The average seed number per stem is 250 (Stevens, 1932). Guyot *et al.* (1962) give the seed numbers per plant as 1,000 to 10,000. The average seed number per plant is 1,000 according to Stevens (1957) or 682 according to Pawlowski *et al.* (1970). The average 1,000 seed weight ranges between 0.3 and 0.5g. There were differences in the mean weight of seeds from populations of different ages (Escarré & Houssard, 1988). Younger populations tended to produce lighter seeds that germinated well. Fertilizer levels applied during growth of the parent plant also affected mean seed weight and germination level.

Fresh seed germinated very poorly but germination improved slowly in dry storage (Povilaitis, 1956). Stratification at 1 to 7^{o}C for 20 weeks did not improve germination levels. Scarification increased the germination of dry-stored but not fresh seed. The extent of the scarification needed varies with the thickness of the seed coat. Alternating temperatures between 20 and 30^{o}C increased the germination of sheep's sorrel seed compared with a constant 20^{o}C (Deschênes & Moineau, 1972). Germination was greater under light conditions than in the dark. In alternating temperatures, seed scarification reduced the light requirement. In Petri dish tests with seed maintained under high or low light intensity or in darkness, seed germination was around 50 to 70% under all conditions (Grime & Jarvis, 1976). Germination is promoted by nitrate (Grime *et al.,* 1988).

Seed sown in a 75 mm layer of soil in cylinders sunk in the field and stirred periodically emerged from February to October but flushes tended to follow cultivations (Roberts & Boddrell, 1985). Seeds germinate intermittently in spring (Putwain, 1970). Seedling emergence and survival is influenced by climate, particularly rainfall. Seedlings establish in disturbed areas and are intolerant of shade (Weber, 2003).

Sheep's sorrel produces adventitious buds on the horizontal roots (Clapham *et al*., 1987). The rootstock is like a slender rhizome lying from 1 to 5 cm beneath the soil surface and branching at irregular intervals (Linton, 1892). Extension occurs chiefly in summer and autumn after flowering and seed ripening. Rhizome branches show fresh vigour in July. New shoots may develop from nodes on the rhizome, these curve up to the soil surface to form a new plant with a small rosette of leaves. Fragments of root readily grow into new plants (Weber, 2003). Shoots dieback in the autumn (Grime *et al.,* 1988).

The sex ratios of natural populations of sheep's sorrel, observed in populations of different ages, show female ramets to be more frequent in younger populations while males predominated in older ones (Escarré *et al.,* 1987). Populations raised from seed have a sex ratio of 1:1 (Putwain & Harper, 1972). Following establishment there is an initial shift towards a 2:1 ratio of females to males but this reverses with time. Seed production represents a high energy cost which consumes root reserves making

females less able to survive unfavourable conditions. There is also a gradual shift in resource allocation from reproductive to vegetative growth that may represent some strategy of colonisation or persistence of the species that is expressed in the changing sex ratio with time (Escarré & Houssard, 1989; Escarré & Houssard, 1985). The sex ratio is unaffected by plant density or a period of vegetative reproduction (Putwain & Harper, 1972).

Persistence and Spread

Thompson *et al*. (1993) suggest that based on its seed characters sheep's sorrel should persist for more than 5 years. In an acidic grassland with ant-hills present, sheep's sorrel seeds were far less numerous in the ant-hill soil than in soil from the undisturbed sward (King, 1976). Seed kept in dry storage retained over 80% viability after 5 years (Kjaer, 1940). Seed buried in soil gave 14% germination after 5 years.

Sheep's sorrel spreads by seed. Apparently-viable seed has been found in samples of cow manure (Pleasant & Schlather, 1994). Seed is found in cattle, horse, goat and pig droppings (Salisbury, 1961). Viable seeds have been found in pigeon droppings and seedlings have been raised from the excreta of various birds. Sheep's sorrel seeds can occur as a contaminant of horticultural peat (Grime *et al.*, 1988). The seeds may be carried by flood water (MacNaeidhe & Curran, 1982).

Sheep's sorrel seed was an impurity in alsike and other clover seed. In clover and grass seed samples tested in Denmark for the period 1966-69, 1955-57, 1939 and 1927-28, sheep's sorrel seed was a contaminant in 3.5, 29.6, 37.6 and 37.1% of samples respectively (Olesen & Jensen, 1969). In samples tested in 1960/61 and 1963/64 it was not a frequent contaminant in English grass seed but high rates were found in Irish ryegrass and New Zealand white clover (MacKay, 1964). It occurred in around 25% of Italian and perennial ryegrass of Irish origin tested in 1960/61 and 6 to 11% of Danish ryegrass seed (Gooch, 1963). In the same period it was found in 38% of Danish wild white clover seeds tested and 39% of New Zealand white clover.

Sheep's sorrel spreads by vegetative means via adventitious shoots from the lateral creeping roots (Salisbury, 1961, Hanf, 1970). It also regenerates from fragments of the roots (Putwain, 1970).

Management

Improving the condition of the soil will help to get rid of this weed (Long, 1928). An application of lime will be beneficial in this, as will manuring (Morse & Palmer, 1925; Borowiec *et al.*, 1974). Tillage operations, the hoeing of root crops and the removal of the creeping rootstocks will all help to reduce the weed. It is important that only pure crop seeds are sown.

Sheep's sorrel is often locally dominant on heath after burning (Tansley, 1949). It can become dominant soon after burning off the vegetation cover because it has the capacity to rapidly develop adventitious shoots from the shallow root system (Salisbury, 1929).

Sheep's sorrel is grazed by rabbits which reduces flowering and seed production (Gillham, 1955). Cutting or mowing results in rapid regrowth (Weber, 2003). Small

patches can be dug out but the crowns and roots must be removed. Deep burial is probably fatal to rhizome fragments (Linton, 1892).

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

References

Barker J (2001). *The medicinal flora of Britain and Northwestern Europe*, Winter Press, West Wickham, Kent, UK.

Borowiec S, Skrzyczyska J, Kutyna I (1974). The effects of fertilisation and liming on the constancy of occurrence and numbers of weeds on sandy soils on loam. *Ekologia Polska* **22** (2), 319-337.

Brenchley W E (1911). The weeds of arable land in relation to the soils on which they grow. *Annals of Botany* **25**, 155-165.

Brenchley W E (1913). The weeds of arable soil III. *Annals of Botany* **27**, 141-166.

Brenchley W E (1920). *Weeds of Farm Land*. Longman, Green & Co., London, UK.

Chancellor R J (1959). Identification of seedlings of common weeds. *MAFF Bulletin No.* **179**. HMSO, London.

Clapham A R, Tutin T G, Moore D M (1987). *Flora of the British Isles*, 3rd edition, Cambridge University Press, Cambridge, UK.

Deschênes J-M & Moineau D (1972). Conditions de germination de quatre mauvaises herbes du Québec. *Le Naturaliste Canadien* **99**, 103-114.

Escarré J & Houssard C (1985). Genotypic and phenotypic variation within *Rumex acetosella* L. populations along a secondary succession. *NATO ASI Series, Vol. G5, Genetic Differentiation and Dispersal in Plants*. (Ed. P. Jacquard *et al.*), Springer-Verlag, Berlin Heidelberg.

Escarré J & Houssard C (1988). Aptitudes germinatives comparées de graines de *Rumex acetosella* issues de populations correspondant à des stades distincts d'une succession postculturale. *Canadian Journal of Botany* **66**, 1381-1390.

Escarré J & Houssard C (1989). Variations de populations de *Rumex acetosella* L. le long d'une succession secondaire: I. Allocation de biomasse. *Acta Oecologia / Oecologia Plantarum* **10** (1), 3-19.

Escarré J, Houssard C, Briane J P (1987). Évolution du rapport des sexes de populations de *Rumex acetosella* le long d'une succession postculturale. *Canadian Journal of Botany* **65**, 2668-2675.

Forsyth A A (1968). British poisonous plants. *MAFF Bulletin No.* **161**, HMSO, London.

Frankton C & Mulligan G A (1970). *Weeds of Canada.* Publication 948, Canada Department of Agriculture.

Gillham M E (1955). Ecology of the Pembrokeshire Islands: III. The effect of grazing on the vegetation. *Journal of Ecology* **43** (1), 172-206.

Gooch S M S (1963). The occurrence of weed seeds in samples tested by the official seed testing station, 1960-1. *The Journal of the National Institute of Agricultural Botany* **9** (3), 353-371.

Greig J (1988). Traditional cornfield weeds – where are they now? *Plants Today* (November-December 1988), 183-191.

Grime J P, Hodgson J G, Hunt R (1988). *Comparative Plant Ecology*, Unwin Hyman Ltd, London, UK.

Grime J P & Jarvis B C (1976). Shade avoidance and shade tolerance in flowering plants II. Effects of light on the germination of species of contrasted ecology. Reprinted from: *Light as an Ecological Factor :II, The 16th Symposium of the British Ecological Society, 1974*, Blackwell Scientific Publications, Oxford, 525-532.

Guyot L, Guillemat J, Becker Y, Barralis G, Demozay D, Le Nail Fr (1962). *Semences et Plantules des Principales des Mauvaises Herbes.* Association de Coordination Technique Agricole, Paris.

Hanf M (1970). *Weeds and their seedlings.* BASF UK Ltd.

Hanson C G & Mason J L (1985). Bird seed aliens in Britain. *Watsonia* **15**, 237-252.

Heathcote G D (1970). Weeds, herbicides and plant virus diseases. *Proceedings of the 10th British Weed Control Conference*, 934-941.

Joenje W & Kleijn D (1994). Plant distribution across arable field ecotones in the Netherlands. *BCPC Monograph No. **58**: Field margins: integrating agriculture and conservation*, 323-328.

King T J (1976). The viable seed contents of ant-hill and pasture soil. *New Phytologist* **77**, 143-147.

Kjaer A (1940). Germination of buried and dry stored seeds. I. 1934-1939. *Proceedings of the International Seed Testing Association* **12**, 167-190.

Lawson H M, Wright G McN, Smoktunowicz N T (1982). Weed seed populations in swede turnip fields in Scotland. *Proceedings VIIeme Colloque International sur la Biologie, L'Ecologie et la Systematique des Mauvaise Herbes*, 33-42.

Lee O C & Doyle L P (1940). Indiana plants poisonous and injurious to livestock. *Extension Bulletin* **240** (Revised), Purdue University Agricultural Extension Service, Lafayette, Indiana, pp. 24.

Linton E F (1892). Propagation of *Rumex acetosella* L. *Journal of Botany* **XXI** New Series, 261-262.

Long H C (1938). Weeds of arable land. *MAFF Bulletin* **108**, 2nd edition. HMSO, London, UK.

Lousley J E & Kent D H (1981). Docks and knotweeds of the British Isles. *BSBI Handbook No.* **3**. Botanical Society of the British Isles, London.

MacKay D B (1964). The incidence and significance of injurious weed seeds in crop seed. *Proceedings 7th British Weed Control Conference*, Brighton, UK, 583-591.

MacNaeidhe F S & Curran P L (1982). Weed colonisation of bog taken into cultivationand seed dormancy of *Polygonum* invaders. *Irish Journal of Agricultural Research* **21**, 199-209.

Morse R & Palmer R (1925). *British weeds their identification and control*. Ernest Benn Ltd, London.

Olesen M & Jensen H A (1969). (Occurrence of weed seeds in seed samples of grasses and clover). *Soertryk af statsfrøkontrollens beretning* **98**, 91-112.

Pawlowski F, Kapeluszny J, Kolasa A, Lecyk Z (1970). The prolificacy of weeds in various habitats. *Annales Universitatis Mariae Curie-Sklodowska Lublin-Polonia,* **25** (5), 61-75.

Pleasant J MT & Schlather K J (1994). Incidence of weed seed in cow (*Bos* sp.) manure and its importance as a weed source for cropland. *Weed Technology* **8**, 304-310.

Povilaitis B (1956). Dormancy studies with seeds of various weed species. Comptes rendus de l'Association Internationale d'Essais de Semances **21**, 88-111.

Putwain P D (1970). The population dynamics of *Rumex acetosa* L. and *Rumex acetosella* L. *Proceedings of the 10th British Weed Control Conference*, Brighton, UK, 12-19.

Putwain P D & Harper J L (1972). Studies in the dynamics of plant populations: V. Mechanisms governing the sex ratio in *Rumex acetosa* and *R. acetosella*. *Journal of Ecology* **60** (1), 113-129.

Roberts H A & Boddrell J E (1985). Seed survival and seasonal emergence in some species of *Geranium*, *Ranunculus* and *Rumex*. *Annals of Applied Biology* **107**, 231-238.

Salisbury E (1962). The biology of garden weeds. Part I. *Journal of the Royal Horticultural Society* **87**, 338-350 & 390-404.

Salisbury E J (1929). The biological equipment of species in relation to competition. *Journal of Ecology* **17** (2), 197-222.

Salisbury E J (1961). *Weeds & Aliens*. New Naturalist Series, Collins, London.

Stace C (1997). *New Flora of the British Isles*. 2nd edition. Cambridge University Press, Cambridge, UK.

Stevens O A (1932). The number and weight of seeds produced by weeds. *American Journal of Botany* **19**, 784-794.

Stevens O A (1957). Weights of seeds and numbers per plant. *Weeds* **5**, 46-55.

Tansley A G (1949). The British Islands and their vegetation. Volume II, 2nd Edition, Cambridge University Press.

Thompson K, Band S R, Hodgson J G (1993). Seed size and shape predict persistence in soil. *Functional Ecology* **7**, 236-241.

Warwick M A (1984). Buried seeds in arable soils in Scotland. *Weed Research* **24**, 261-268.

Weber E (2003). *Invasive plant species of the world. A reference guide to environmental weeds*. CABI Publishing, Cambridge, UK.