

The biology and non-chemical control of White Campion (*Silene latifolia* Poir.)

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White campion

(cow-rattle, cockle, cuckoo flower, thunder-flower, white bachelors button, white cockle, white robin)

***Silene latifolia* Poir.**

(*S. alba*, *Lychnis alba*, *L. vespertina*, *Melandrium album*)

Occurrence

White campion is an annual, biennial or short-lived perennial frequent on roadsides, field borders, hedgerows, waste places and grassy banks throughout Britain (Clapham *et al.*, 1987; Stace, 1997). British plants probably arrived in the Neolithic period and are the subspecies *alba*. In an early survey of Bedfordshire and Norfolk, white campion was found on all soil types, although it was chiefly associated with lighter soils (Brenchley, 1913). It was often widespread but occurred in small numbers only. It does not grow well on waterlogged soils but is deep rooted and resistant to drought. As a plant suited to soils with a high soil moisture deficit in summer, it is frequent in the field margins of the Breckland region of East Anglia (ADAS, 1997). A lowland, sun-loving plant, white campion is most abundant in southern and eastern England. White campion occurs on the margins of woodland and can become established after felling or when coppicing has taken place (Baker, 1947). It disappears again once the trees regenerate and the habitat becomes shady. It performs less well in the shade (McNeill, 1977). Where it has been introduced into North America, high spring and summer temperatures restrict its distribution in the southern states.

There is evidence that white campion was a weed of crops in the Iron Age (Greig, 1988). White campion is a weed of cultivated land mainly on light calcareous or sandy soils of pH 6.1 to 8.2 (Baker, 1947). It was often an abundant weed on chalky ground (Morse & Palmer, 1925). The species is often found spreading into arable fields from the hedge bottom (Marshall, 1989). It occurs in cereals, grass/clover mixtures and in fallow arable fields (Baker, 1947). It was thought to be discouraged by root crops but was often associated with temporary grass or clover grown for seed (Brenchley, 1920). In a survey of weeds of conventional winter oilseed rape in central southern England in 1985 it was found in 5% of the fields surveyed (Froud-Williams & Chancellor, 1987).

White campion can hybridise with red campion (*S. dioica*) and various intermediate forms occur (Chancellor, 1959). The hybrids have pale pink flowers.

Extracts from the leaves are toxic to mosquito larvae (McNeill, 1977). Cucumber mosaic virus can overwinter in white campion. Tobacco mosaic virus (TMV) has also been isolated from it.

Biology

White campion is a long-day plant and flowers from May to September (Clapham *et al.*, 1987). Male and female flowers occur on different plants (McNeill, 1977). There

is usually a predominance of female plants in natural populations. Pollination is by night flying moths. The immature seeds become viable 2-3 weeks after pollination. The seeds ripen and the capsule opens 4-5 weeks later (Baker, 1947). Each seed capsule contains between 48 and 359 seeds, or perhaps up to 500 seeds. A plant may have 66 capsules (McNeill, 1977). There are 5,000 to 15,000 seeds per plant according to Salisbury, (1961), 8,440 seeds per plant according to Stevens (1957) and 24,000 seeds per plant according to McNeill (1977). The average seed number per plant in a ruderal situation is given as 11,324 (Pawłowski *et al.*, 1967). The 1,000 seed weight is 0.580 g.

Germination takes place whenever conditions are favourable (Baker, 1947). There may be some initial dormancy that is overcome by chilling. Germination is promoted by alternating temperatures and light. Fresh and dry-stored seed of white campion from separate populations in Europe differed in the proportion of seeds that germinated or were dormant (Thompson, 1975). There were also differences in the rate of germination at certain key temperatures. Dry-stored seed was less dormant than fresh seed and germinated more readily over a range of temperatures. The minimum optimal germination temperature is between 11 and 15°C, the maximum optimal germination temperature is between 28 and 31°C (McNeill, 1977). When seeds were put to germinate under a leaf canopy or in diffuse white light there was 7% germination under the canopy and 36% in the light (Górski *et al.*, 1977).

Seed sown in a 75 mm layer of soil in cylinders sunk in the field and stirred at intervals, emerged from February to October (Roberts & Boddrell, 1984). There was a peak of seedling emergence from March to May and a smaller one in July–August. Variable amounts of seed remained after 5 years. White campion seedlings can emerge from 40 mm deep in soil but most arise from the upper 10 to 15 mm (Baker, 1947). Burial at 25 to 150 mm deep may prevent germination in the field (McNeill, 1977).

White campion can behave as a summer annual when seeds germinate in spring. If it emerges later in the year white campion may behave as a biennial or short-term perennial (Baker, 1947). White campion overwinters as a leaf rosette. New leafy shoots develop in March and the old leaves shrivel. Leafy stolons that lay on the ground, root into the soil. White campion has thick fleshy roots (Frankton & Mulligan, 1970). The root crown bears numerous adventitious buds that can produce new plants if fragmentation occurs (McNeill, 1977). Plants are not completely hardy in winter (Salisbury, 1961).

Persistence and Spread

Seed recovered from archaeological digs and house demolitions is said to have germinated after 70 years burial (Ødum, 1974). White campion seed buried in mineral soil at 13, 26 or 39 cm depth and left undisturbed retained 52, 17 and 31% viability respectively after 4 years but only 1-2% viability after 20 years (Lewis, 1973). Seed buried in a peat soil at 26 cm retained little viability after just 1 year. Seed stored under granary conditions had 27% viability after 1 year but was not viable after 20 years. In studies with white campion seeds buried at 2.5, 10.0 or 17.8 cm deep in soils with different water tables, most of the seeds were recovered after 1 month of burial but germination was relatively low (Lewis, 1961). The poorest germination levels were from seeds buried in a peat soil.

White campion reproduces by seed and possibly by fragmentation of the rootstock (Hanf, 1970). Ploughing can break up the plant and severed portions of rootstock may generate leafy stolons from the adventitious buds (Baker, 1947). The plant fragments are susceptible to desiccation (McNeill, 1977).

White campion seed has occurred as an impurity in samples of crop seeds (Long, 1938). The seed was frequently introduced when sowing grasses and clovers (Morse & Palmer, 1925). White campion seed was found as a contaminant in 17% of red clover seeds tested in 1951-52 (Gooch, 1963). In 1960-61 it was found in 9-15% of red clover seed samples of English origin and 4% of samples from New Zealand and Canada. In white clover seed samples tested in 1960-61 it was found in 23% of English samples and 26% of Danish samples. It was also a contaminant in wild white clover seed samples. Additionally in 1960-61, white campion seed was found in 4.1% of perennial ryegrass seed samples, 2.8% of Italian ryegrass, 6.2% of cock's-foot, 1.4% of Timothy, 10.2% of meadow fescue and 9.1% of tall fescue seed samples tested. It was also found in 2-10% of vegetable brassica, 2% of carrot and 2% of leek seed samples tested. In a survey of weed seed contamination in cereal seed in drills ready for sowing on farm in spring 1970, it was found in 1% of samples (Tonkin & Phillipson, 1973). Most of this was home saved seed.

There may be some dispersal of the seed when it is shaken from the capsule by the wind (Baker, 1947). Apparently-viable seeds have been found in samples of cow manure (Pleasant & Schlather, 1994).

Management

Plants growing in pasture, leys and along field borders should be cut periodically at ground level to prevent seeding (Long, 1938; Morse & Palmer, 1925). Hand pulling may be required in some crops.

The plant cannot tolerate burial by ploughing, mechanical injury during cultivation or desiccation if left uprooted on the soil surface (McNeill, 1977).

White campion survives burning on railway embankments and field margins (Baker, 1947). It is resistant to mowing, and decapitation merely ensures it will remain perennial. In the rosette stage it is unaffected by trampling but the tall flowering stems are readily trodden down. According to Baker (1947), white campion is not eaten by rabbits. However, Gillham (1955) suggests that white campion suffers badly when grazed by rabbits.

The larvae of several species of moth feed on the seeds within the capsules (Morse & Palmer, 1925). *Harmodia capsicola* can severely diminish seed production. Infection by *Fusarium* spp. causes rotting of the seeds in the soil and damping off of seedlings (Baker, 1947).

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References

- ADAS** (1997). Biological Monitoring of Arable Field Margins in the Breckland ESA 1986-1996. *ADAS Report to the Ministry of Agriculture, Fisheries & Food, UK*.
- Baker H G** (1947). Biological flora of the British Isles. *Melandrium album* (Mill.) Garcke. *The Journal of Ecology* **35** (1/2), 274-282.
- Brenchley W E** (1913). The weeds of arable soil III. *Annals of Botany* **27**, 141-166.
- Brenchley W E** (1920). *Weeds of Farm Land*, Longmans, 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.
- Frankton C & Mulligan G A** (1970). *Weeds of Canada*. Publication 948, Canada Department of Agriculture.
- Froud-Williams R J & Chancellor R J** (1987). A survey of weeds of oilseed rape in central southern England. *Weed Research* **27**, 187-194.
- 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.
- Górski T, Górska K, Nowicki J** (1977). Germination of seeds of various herbaceous species under leaf canopy. *Flora Bd* **166**, 249-259.
- Greig J** (1988). Traditional cornfield weeds – where are they now? *Plants Today* (November-December 1988), 183-191.
- Hanf M** (1970). *Weeds and their seedlings*. BASF UK Ltd.
- Lewis J** (1961). The influence of water level, soil depth and type on the survival of crop and weed seeds. *Proceedings of the International Seed Testing Association* **26** (1), 68-85.
- Lewis J** (1973). Longevity of crop and weed seeds: survival after 20 years in soil. *Weed Research* **13**, 179-191.
- Long H C** (1938). Weeds of arable land. *MAFF Bulletin* **108**, 2nd edition. HMSO, London, UK.
- Marshall E J P** (1989). Distribution patterns of plants associated with arable field edges. *Journal of Applied Ecology* **26**, 247-257.
- McNeill J** (1977). The biology of Canadian weeds. 25. *Silene alba* (Miller) E. H. L. Krause. *Canadian Journal of Plant Science* **57**, 1103-1114.
- Morse R & Palmer R** (1925). *British weeds their identification and control*. Ernest Benn Ltd, London.
- Ødum S** (1974). Seeds in ruderal soils, their longevity and contribution to the flora of disturbed ground in Denmark. *Proceedings of the 12th British Weed Control Conference*, Brighton, UK, 1131-1144.
- Pawlowski F, Kapeluszný J, Kolasa A, Lecyk Z** (1967). Fertility of some species of ruderal weeds. *Annales Universitatis Mariae Curie-Sklodowska Lublin-Polonia* **22** (15), 221-231.
- Pleasant J M T & 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.

- Roberts H A & Boddrell J E** (1984). Seed survival and seasonal emergence of seedlings of some ruderal plants. *Journal of Applied Ecology* **21**, 617-628.
- 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** (1957). Weight of seeds and numbers per plant. *Weeds* **5**, 46-55.
- Thompson P A** (1975). Characterization of the germination responses of *Silene dioica* (L.) Clairv., populations from Europe. *Annals of Botany* **39**, 1-19.
- Tonkin J H B & Phillipson A** (1973). The presence of weed seeds in cereal seed in cereal drills in England and Wales during spring 1970. *Journal of the National Institute of Agricultural Botany* **13**, 1-8.