

The biology and non-chemical control of Meadow Buttercup (*Ranunculus acris* L.)

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Meadow buttercup

(common buttercup, tall buttercup)

***Ranunculus acris* L.**

Occurrence

Meadow buttercup is an erect perennial, native in grassland especially on damp and calcareous soils (Stace, 1997). It is associated with meadow habitats (Gibson, 1997). In an early survey of Bedfordshire and Hertfordshire it was most frequent on chalk and light loam, not on gravel and rarely on very sandy soil (Brenchley, 1911). Meadow buttercup is not markedly a calcicole or calcifuge being abundant on both alkaline alluvial meadows, base rich clays and on the acid peat of mountain uplands. Meadow buttercup has a preference for poorly drained, medium textured to stony soils of pH 4.6 to 7.3 (Dale *et al.*, 1965). It is found on chalk grassland and alkaline clay soils (Harper, 1957). It is recorded up to 4,000 ft in Britain (Salisbury, 1961).

Meadow buttercup is a serious weed of old pastures and hay meadows (Harper & Sagar, 1953). It is characteristically found on grazed and mown grassland, abundance is considered an index of the age of a pasture. Meadow buttercup is often confined to permanent pasture under lax management (Grime *et al.*, 1988). In a survey of seeds in pasture soils in the Netherlands in 1966, meadow buttercup was common in the sward and in the soil seedbank (Van Altena & Minderhoud, 1972). It is sometimes found in woodland and may occur as seedlings on arable land (Harper, 1957).

The pattern of distribution in the UK does not seem to be related to climate. Meadow buttercup is frost tolerant, and flowering is over before there is any risk of drought. It prefers intermediate conditions of moisture and drainage and is found on the slope of the ridges on ridge and furrow grassland. Nevertheless it is found in habitats with a good water supply both from rainfall and a high water table. Meadow buttercup is not tolerant of trampling.

Meadow buttercup is a very variable species with several sub-species known but only ssp. *acris* is native in Britain (Clapham *et al.*, 1987). Three varieties have been recognised and a white flowered form is sometimes found (Stace, 1997). Much of the variation is due to differences in growing conditions but some ecotypes have developed to suit particular habitats (Harper, 1957). There is considerable plasticity in response to soils, competition and habitat. In New Zealand, some populations of meadow buttercup have developed resistance to the herbicide MCPA (Bourdôt *et al.*, 1989). Meadow buttercup is considered to be moderately susceptible to the herbicide and resistance is correlated with previous herbicide use (Bourdôt *et al.*, 1990). There is little difference in competitive ability between susceptible and resistant biotypes, making reversion back to susceptible biotypes unlikely even if herbicide use is discontinued.

Cattle usually avoid meadow buttercup because of the high ranunculin content and it can come to dominate the pasture (Sarukhán & Harper, 1973). The plant can cause inflammation of the digestive system in cattle if eaten fresh but is okay when dried in hay (Salisbury, 1961).

Biology

Meadow buttercup flowers mainly from May to July (Clapham *et al.*, 1987). It is self-sterile in some populations and apomixis may occur. In England, peak flowering happens at the end of May in the south, in mid-June in the Midlands and in late-June in the north (Harper, 1957). Flowering may continue to October in some areas. The flowers are visited by a number of pollinating insects. Flowering lasts for 2 months, after which most seeds (achenes) have ripened and shed. The first fruits appear in mid-June, and peak fruiting is in Mid-August (Sarukhán, 1974). Flower heads contain 30 seeds, and a large plant may have 22,000 seeds (Salisbury, 1961). Guyot *et al.* (1962) give the seed numbers per plant as 200 to 1,000. The seeds vary in size and weight (Harper, 1957). The 1,000 seed weight ranges from 1.43 to 1.60 g.

Seedling emergence occurs in autumn and spring. The spring flush is in February-March (Harper, 1957) but emergence may extend into August (Sarukhán, 1974). Seed sown in a 75 mm layer of soil in cylinders sunk in the soil and stirred periodically, emerged from January to April with no seedlings emerging at other times of year (Roberts & Boddrell, 1985). Most seedlings emerged in year 1 with a few seedlings appearing in years 2 to 4 but none in year 5. Seedlings tend to occur in clumps or patches and there is heavy mortality at the seedling stage (Harper, 1957). Meadow buttercup does not establish well from seed in well-drained soils. It is the effect of the water table on germination and early seedling growth that determines the distribution of meadow buttercup along the sides of the ridges in ridge and furrow grassland (Harper & Sagar, 1953).

After flowering, the summer leaves die and meadow buttercup passes the winter as a rosette of small leaves (Harper, 1957). The rosette appears to be unaffected by frost. The plant also has a short creeping rhizome up to 5 cm long which is relatively persistent. The rhizome is dark brown to black with adventitious roots and the remains of the old leaf bases. It is densely packed with starch and contains the glucoside ranunculin. In February-March there is a rapid formation of new leaves and the starch reserves disappear from the rhizome. The rhizome may rot away after this and at the time of flowering no rhizome may be present. However, sometimes the rhizomes remain and show evidence of the previous years growth. Meadow buttercup does not have a summer rest period (Sarukhán & Harper, 1973).

Persistence and Spread

Meadow buttercup may form a relatively persistent seedbank but few buried seeds have been recorded in soils under pasture. Seed stored in the laboratory has remained viable for 4 years. In cultivated soil seeds persisted for up to 4 years (Roberts & Boddrell, 1985).

Meadow buttercup employs both seed and vegetative reproduction but the latter is restricted by the shortness of the rhizomes (Sarukhán, 1974; 1970). It therefore relies on seed production to maintain existing populations and spread to new sites. In the autumn a small branch of the rhizome produces a new vegetative shoot close to the

parent (Sarukhán & Harper, 1973). The connection decays as the plant develops resulting in a tightly clumped colony of plants over time. Plants in meadows have been shown to have a half-life of 3 years.

Meadow buttercup flowers at the time when most hay meadows are cut so it cannot rely completely on seed for persistence (Harper, 1957; Grime *et al.*, 1988). When seed is produced there is no obvious dispersal mechanism and seeds tend to fall around the parent plant. Seeds are eaten by birds but it is doubtful if any seeds remain viable after digestion. Seeds are predated also by voles and mice (Sarukhán, 1974).

Management

In arable land, frequent and thorough cultivation is important for the control of meadow buttercup (Morse & Palmer, 1925). Two fallow crops should be taken in succession to clean the land, and mustard may be sown as a smother crop.

In pasture, buttercups should be cut to prevent seeding. However, although plant vigour is reduced meadow buttercup can survive frequent cutting for hay and is tall enough to withstand competition from uncut grass. In grazing studies, meadow buttercup was unaffected by different strategies of tight and lenient grazing in pasture (NERC, 2006). Meadow buttercup is avoided by grazing animals, including cattle, sheep and rabbits, due to the acrid sap that contains protoanemonin (Clapham *et al.*, 1987; Harper, 1957). Sheep are less averse to it than cattle and mixed stocking may help to keep it in check (Popay & Field, 1996). In grassland studies, cattle grazing resulted in an increased frequency of meadow buttercup compared with sheep grazing (Pywell *et al.*, 2003). Meadow buttercup remains as conspicuous clumps in grazed pasture and its presence reduces productivity (Frankton & Mulligan, 1970).

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