

The biology and non-chemical control of Scarlet Pimpernel (*Anagallis arvensis* L.)

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Scarlet pimpernel

(bird's eye, bird's tongue, John-go-to-bed-at-noon, merecrop, poor-man's weather-glass, shepherd's calender, shepherd's sundial, shepherd's weatherglass, tom pimpernowl, waywort, weather glass, wincopipe, wink-a-peep)

Anagallis arvensis L.

Occurrence

Scarlet pimpernel is a native summer or winter annual, sometimes perennial weed (Clapham *et al.*, 1987). It is not recorded above 1,100 ft in Britain (Salisbury, 1961). It has spread worldwide, probably as a contaminant in crop seeds (Holm *et al.*, 1977). Scarlet pimpernel is widely distributed in the UK especially on calcareous soils but is rarely abundant enough to be a problem (Long, 1938). It is a common garden weed (Copson & Roberts, 1991). In early surveys of Bedfordshire, Hertfordshire and Norfolk it was universally distributed but scarce on chalk (Brenchley, 1911; 1913). It prefers soils in the pH range from 5.5 to 8.0 (Grime *et al.*, 1988). It is an indicator of loam (Hanf, 1970). Scarlet pimpernel grows in light shade but is seldom found in dense shade (Holm *et al.*, 1977). At early growth stages it grows better in light shade than in full sun.

Scarlet pimpernel occurs in cultivated fields, gardens, lawns, meadows, pastures and waste places (Holm *et al.*, 1977). It is common on arable land especially in spring-sown crops (Grime *et al.*, 1988). In a survey of weeds in conventional cereals in central southern England in 1982, scarlet pimpernel was found in 1, 0.5 and 2% of winter wheat, winter barley and spring barley respectively (Chancellor & Froud-Williams, 1984). It was frequently associated with cereals and was considered to be discouraged by root crops (Brenchley, 1920). However, scarlet pimpernel was one of the main weed species present in conventional sugar beet crops surveyed in East Anglia in autumn 1998 (Lainsbury *et al.*, 1999). It was also common in the field margins. In a study of seedbanks in arable soils in the English midlands sampled in 1972-3, seed was recorded in 63% of fields sampled in Oxfordshire and 50% in Warwickshire but never in high numbers (Roberts & Chancellor, 1986). In seedbank studies in arable fields in France, scarlet pimpernel was well represented in the seedbank and in the emerged vegetation (Barralis & Chadoeuf, 1987).

Numerous forms and varieties exist (Holm *et al.*, 1977). Two subspecies are recognised in Britain. Subspecies *arvensis* (Syn. ssp. *phoenica*) with red flowers is found on cultivated land, by roadsides and on dunes throughout the UK (Clapham *et al.*, 1987; Stace, 1997). Subspecies *foemina* with blue flowers is found in arable fields in S & W England but is rare. It is now considered nationally scarce (Wilson, 1994).

Scarlet pimpernel is poisonous if ingested by man, dogs and horses (Holm *et al.*, 1977). It may cause dermatitis if handled. Under normal UK conditions animals are unlikely to consume sufficient of the plant to suffer injury (Forsyth, 1968).

Biology

Scarlet pimpernel flowers from June to August (Clapham *et al.*, 1987), April to August (Holm *et al.*, 1977), or April until October (Hanf, 1970). The flowers are self- or more rarely insect pollinated (Grime *et al.*, 1988). There are 35 to 40 seeds per seed capsule (Guyot *et al.*, 1962). The average seed number per plant is around 900 but a large plant may yield 12,000 seeds. In cereal crops and winter rape the average seed number per plant ranged from 122 to 146 and in root crops from 1,663 to 2,260 (Pawlowski, 1966). Plants can be found in fruit for 4 months of the year (Salisbury, 1962). The time from germination to fruiting is around 100 days (Guyot *et al.*, 1962). The seeds are mature 6 to 8 weeks after anthesis but some may be germinable within 3 weeks (Holm *et al.*, 1977). When seed was collected from plants at different times after flowering and stored for a short period before germination was tested, there was 4% germination of seed harvested 15, 20 and 25 days from flowering (Chakravarti & Pershad, 1953).

The seeds have some dormancy and seed from different sources may vary in the degree of dormancy (Holm *et al.*, 1977). Seeds contain a water soluble germination inhibitor. Dormancy in mature seed is broken by chilling (Grime *et al.*, 1988). Seeds also require light for germination (Holm *et al.*, 1977). Scarlet pimpernel seed germinates better at moderately low temperatures. Germination will occur at 2-5°C but the optimum is 7-20°C. The level of seed germination increased from 7 to 58% following a 13-month period of moist storage at 5°C (Grime *et al.*, 1981).

The seed rain from plants that emerged following cultivation in April resulted in final seed numbers in soil of 1,080 per m² to 10 cm depth (Leguizamón & Roberts, 1982). No seeds of scarlet pimpernel were detected in the initial soil samples.

Scarlet pimpernel emerges in autumn and spring (Salisbury, 1961). Seed sown in pans of field soil emerged chiefly in winter with little emergence in spring and summer (Brenchley & Warington, 1930). Seedlings continued to emerge for 3 further years. Seed sown in a 75 mm layer of soil in cylinders sunk in the field and stirred three times during the year, emerged mainly in April-May with only odd seedlings emerging at other times (Roberts & Boddrell, 1983). Field emergence was recorded in plots cultivated at monthly, 3 monthly and yearly intervals or not at all (Chancellor, 1964). Most emergence took place between March and October with peaks in March-May and August-September. Dry weather in June was thought to be responsible for poor emergence in summer. Plants are frost tolerant and can overwinter after autumn germination (Grime *et al.*, 1988).

In a sandy loam soil, field seedlings emerged from the top 40 mm of soil with the majority coming from the upper 25 mm (Unpublished information).

Persistence and spread

Seed was able to remain dormant in soil for at least 10 years (Brenchley & Warington, 1936). Seed longevity in soil is 6 to 7 years (Guyot *et al.*, 1962). Seed recovered from excavations and dated at 20, 30 and 150 years old was reported to have germinated (Ødum, 1974). Seeds in dry storage remain viable for 8 years (Brenchley, 1918).

Scarlet pimpernel seed was a common impurity in clover seed. In a survey of weed seed contamination in 1960-61, scarlet pimpernel seed was found in 4% of carrot, 6% of lettuce and 4% of celery seed samples tested (Gooch, 1963). The seeds have been found in the droppings of gulls and seedlings have been raised from the excreta of various birds (Salisbury, 1961). Viable seeds have been found in worm cast soil (McRill, 1974).

Management

Scarlet pimpernel is found growing in a range of crops. It is not a very competitive weed but is able to grow at low light levels (Holm *et al.*, 1977). It can also emerge and grow at relatively low temperatures so can be more of a problem at early crop stages. Normal tillage operations should keep scarlet pimpernel in check (Long, 1938). If it is plentiful, surface cultivations and the inclusion of one or more root crops will reduce it.

In set-aside over a 3-year period, a sown cover of ryegrass or ryegrass/clover had a lower population of scarlet pimpernel than natural regeneration (Boag *et al.*, 1994). With the natural cover, scarlet pimpernel 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. Cattle avoid it in grazing pasture, allowing it to increase (Holm *et al.*, 1977).

Seed numbers in soil were reduced by 75% following a 1-year fallow but there was no further reduction if the fallow was continued for a second year (Brenchley & Warrington, 1933). The land was ploughed, disked and harrowed during each year. Seed numbers were reduced but to a lesser extent by cropping with winter wheat for the same period. Fresh seeding may have occurred at some period in the cropping and fallowing cycle.

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