The biology and non-chemical control of Evening-primrose (*Oenothera* Spp.)

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Evening-primrose *Oenothera* Spp.

Large-flowered evening-primrose	*O. glazioviana* P. Michaeli ex Mart. (*O. grandiflora, O. erythrosepala, O. lamarckiana)*
Common evening-primrose (yellow evening-primrose)	*O. biennis* (*Onagra biennis*)
Small-flowered evening-primrose	*O. cambrica* Rostanski (*O. novae-scotiae, O. ammophila, O. parviflora)*
Fragrant evening-primrose	*O. stricta* Ledeb. Ex Link (*O. odorata*)

Occurrence

Fifteen species of evening-primrose have been recorded in Britain (Rostanski, 1982). Only 4 are common: the large-flowered, the common, the small-flowered and the fragrant evening-primrose. The other species occur as non-persistent introductions from N and S America. Hybrids between the different species also occur. The hybrids are fertile and may backcross and form triple-hybrids (Stace, 1997). Hybridisation and the misidentification of species means that records in Britain are not always reliable. Some plant characters are variable which adds to the confusion.

Common evening primrose is a winter annual or biennial found on roadsides, railway tracks and waste places especially on light-sandy or gravely soils (Hall *et al.*, 1988). It may also be a weed of meadows, pastures, vineyards, fruit crops and neglected fields. It is able to tolerate drought conditions. It has a preference for abandoned sites with well-drained soils low in organic matter (Dale *et al.*, 1965). The common evening primrose was thought to be a European species but it probably arrived in Europe from North America in the 17th century and then spread to Britain in the 19th century. Common evening-primrose was said to be well established on sandhills on the coast of Somerset in 1905 having been first recorded there in 1837 (Thompson, 1905). A population of common evening-primrose consists of many different but intergrading biotypes each of which is an inbreeding line (Hall *et al.*, 1988).

Fragrant evening-primrose from Chile is an annual or biennial. It was discovered on sandhills near Weston-super-mare around 1883, however, herbarium records suggest it was present near Burnham in 1859.

The large and small-flowered evening-primrose are usually biennial. The large-flowered, the commonest British species, was introduced from North America in the mid-19th century and became well established (Clapham *et al.*, 1987). The small-flowered evening primrose was probably introduced from Canada in the 18th century and became established in dunes and waste places particularly in South Wales.

The young leaves of the common evening-primrose can be eaten as a salad (Hall *et al.*, 1988). The fleshy roots are edible as a cooked vegetable (Barker, 2001). The

seeds are rich in beta-linolenic and gamma-linoleic acids which have important medicinal and therapeutic uses. It is cultivated as an oilseed crop using strains with a high oil content. Seed shed prior to and during crop harvest can be extensive leading to its appearance as a volunteer weed in following crops.

Biology

The various evening primroses all flower from June to September. The flowers open in the evening and die within 24 hours. Common evening-primrose flowers are predominately self-pollinated but out-crossing can occur (Hall *et al.,* 1988). Seeds are produced in mid-August. A plant may have around 300 seed capsules each containing on average 160 seeds (Salisbury, 1961). Others suggest that each plant produces on average 140 capsules each containing 180 seeds (Hall *et al.,* 1988). The average seed number per plant is 21,450 according to Pawlowski *et al.* (1970). Seed numbers have also been given as 25,200 per plant (Hall *et al.,* 1988) and 118,500 per plant (Stevens, 1932). The 1,000 seed weight is 0.33 g but can range from 0.2 to 0.6 g. Plants die after setting seed.

Seeds of common evening-primrose do not germinate if buried deeper than 5 mm in soil (Hall *et al.,* 1988). Germination takes place mainly in spring. Exposure to light, abrasion and hot water treatment improves germination. Seedlings emerge and establish best in patches of bare ground (Gross, 1984). Rosettes need to reach at least 3 cm diameter before the winter in order to become vernalised and flower the following year (Hall *et al.,* 1988). New shoot growth from the overwintered rosettes begins in late spring.

Persistence and Spread

Porter (1944) gives the longevity of common evening-primrose seeds in soil as 50 or more years. In Beal's seed burial experiment some seeds were still able to germinate after 80 years (Darlington & Steinbauer, 1961). In Duvel's burial experiment seeds placed at 8, 22 and 42 inches deep in soil gave 48, 67 and 71% germination respectively after 3 years and 61, 88 and 87% germination respectively after 21 years (Goss, 1924). Seed recovered from house demolitions and dated at 30 years old was reported to have germinated (Ødum, 1974). However, in other studies, seed viability was just 4% after 5.5 years burial in soil (Egley & Chandler, 1983). After 30 months soil burial, the apparent viability of common evening-primrose seeds was between 7 and 36% depending on burial depth (Egley & Chandler, 1978). Seeds kept in dry storage at low temperature for the same period retained over 90% viability. Seeds in dry storage for 1, 2 and 3 years gave 96, 58 and 5% germination respectively (Comes *et al.,* 1978). Common evening primrose seeds submerged in water gave 9% germination after 2 years and 4% after 3 years.

Common evening-primrose seeds show no adaptation for dispersal but seeds may be carried up to 4 m by the wind (Hall *et al.,* 1988). They can remain floating in water for 24 hours. Seeds eaten by birds may be voided intact. Seeds can also be carried in mud on tyres and footwear.

Management

Ploughing buries the rosettes and prevents flowering. Hoeing, pulling or mowing before seed set will reduce future populations (Hall *et al.,* 1988). Seedlings of

common evening-primrose cut off below the cotyledonary node have been reported to produce adventitious shoots from the decapitated hypocotyl (Langston *et al.*, 1984).

The seeds are eaten by birds (Hall *et al.*, 1988). A number of insect species feed on the leaves, flower buds and seeds of common evening-primrose. It is also infected by certain strains of downy mildew.

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