

The biology and non-chemical control of Perforate St John's-wort (*Hypericum perforatum*)

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Perforate St John's-wort

(St John's wort, common St John's-wort, Klamath weed, St John's-wort)

Hypericum perforatum L.

Occurrence

Perforate St John's-wort is an erect, rhizomatous perennial native in dry grassland, hedgebanks and open woodland (Stace, 1997; Clapham *et al.*, 1987). It is a garden rather than an arable weed but can be a problem in lightly grazed or poorly managed pasture. It is more of a problem weed in countries like Australia where it was introduced for ornamental or medicinal purposes (Campbell & Delfosse, 1984). Perforate St John's-wort is found throughout the UK and is the commonest *Hypericum* in England. It thrives on calcareous soils and is most abundant on soils with a pH above 7.0. Perforate St John's-wort has a preference for well-drained, coarse to medium textured soils, low in organic matter and with a short vegetation cover (Dale *et al.*, 1965). It is recorded up to 1,500 ft in Britain (Salisbury, 1961). Perforate St John's-wort has a root system that penetrates over 1 m deep and can survive dry conditions but seedlings are sensitive to drought (Crompton *et al.*, 1988).

Perforate St John's-wort is a very variable plant (Stace, 1997). Different ecotypes have been distinguished (Grime *et al.*, 1988). In Canada there is one form that grows on acidic soil and another that grows on calcareous soil (Crompton *et al.*, 1988). Plants from different countries exhibit different growth habits. The Australian form var. *angustifolium* has narrower leaves than the British plant (Campbell & Delfosse, 1984).

Perforate St John's-wort has many medicinal and therapeutic uses (Barker, 2001). It contains phloroglucinols, polycyclic diones, flavonoids and proanthocyanidins. It works as an anti-depressant and anti-inflammatory, and has anti-viral, antibiotic, anti-oxidant and wound healing properties (Crompton *et al.*, 1988; Mitich, 1994).

Sheep and cattle that eat perforate St John's-wort may develop a craving for it (Salisbury, 1961). The plant contains the pigment hypericin that can photosensitise animals that ingest it (Frankton & Mulligan, 1970; Forsyth, 1968). The pigment remains intact during digestion and enters the bloodstream. It responds to visible rather than UV light and is only poisonous to animals following ingestion (Mitich, 1994). Hypericin is stable to drying and poisoning may be caused by contaminated hay. Sheep, cattle, horses and goats are all affected but goats are the least sensitive (Robinson, 1990). The higher light intensity in Australia and New Zealand increases the level of toxicity (Grime *et al.*, 1988). Grazing animals usually avoid it unless no other food is available (Crompton *et al.*, 1988). Plants are thought to be more toxic when in flower (Campbell & Delfosse, 1984).

Biology

Perforate St John's-wort flowers from June to September (Clapham *et al.*, 1987; Grime *et al.*, 1988). The flowers are self-pollinated and usually apomictic. Crompton *et al.* (1988) found the mean number of seeds per capsule was 451 but others suggest around 50 seeds per seed capsule. There may be 73 capsules per plant. The average seed number per plant is 15,000 to 30,000 (Campbell & Delfosse, 1984) or 26,000 to 34,000 (Salisbury, 1961) or 14,816 (Pawlowski *et al.*, 1970). But a plant can produce up to 150,000 seeds (Salisbury, 1929). Seed is shed from August onwards but some seeds overwinter on the plant.

Seeds need an after-ripening period of 4-6 months (Campbell & Delfosse, 1984). Fresh seeds have a greater response to light than older seeds. The germination of fresh seeds was greater in the light and at a relatively low constant temperature of 15°C (Campbell, 1985). In laboratory tests with dry-stored seed on moist paper or soil in the light, there was over 80% germination of seed maintained at both a constant 18-20°C and at alternating temperatures of 20 to 30°C and 8 to 20 to 30°C (Cross, 1930-33). Inhibitors in the seedcoat and in exudate from the seed capsule may influence germination. Washing improves the germination of both fresh and dry-stored seed (Crompton *et al.*, 1988; Campbell & Delfosse, 1984). In the field, seeds germinate in spring when the inhibitors have been washed from the seed coats over winter (Grime *et al.*, 1988). There have been suggestions that calcium in the soil may be detrimental to seed germination but the evidence is contradictory (Crompton *et al.*, 1988). Campbell (1985) found that calcium in solution from CaCO₃ and in soils did not inhibit germination of fresh or old seed. A brief exposure to temperatures of 100-140°C will significantly increase levels of germination.

A few of the seeds sown in a 75 mm layer of soil in cylinders in the field and stirred periodically, emerged in the autumn after sowing in September (Roberts, 1986). In the following and subsequent years, seedlings emerged from February to November with the main peak of emergence from August to October and a smaller one in March. Seedlings continued to emerge in moderate numbers throughout the 5-year study. In an abandoned pasture, seed scattered over the intact vegetation or over cleared areas produced significantly more seedlings on the bare soil (Reader, 1993). The result was similar whether measures were taken to prevent seed predation or not. Seedling emergence is restricted by a 2-4 mm deep covering of soil and completely prevented by a soil covering greater than 4 mm deep (Campbell, 1985). Seedlings are small, relatively slow growing and susceptible to competition from other plants.

The taproot penetrates 70 cm into the soil while other roots grow laterally 5-8 cm below the soil surface and produce buds from which new crowns develop (Campbell & Delfosse, 1984). The root and rhizome system is branched and the laterals spread more or less horizontally just below the soil surface (Salisbury, 1961). Shoot buds form on the roots if the main stems are cut. Some roots penetrate deeply into the soil others are superficial (Grime *et al.*, 1988). The old shoots die at the end of the year while the younger ones overwinter.

Persistence and Spread

Common St John's-wort forms a persistent seedbank. Seeds persisted for more than 5 years in cultivated soil (Roberts, 1986). The longevity of seeds in soil and in dry-storage was 8-10 years (Guyot *et al.*, 1962). Seed in dry-storage gave 94%

germination after 5 years, while seed stored in freshwater retained up to 47% viability after 4 years and 7% after 5 years (Comes *et al.*, 1978).

The small seeds can be blown by the wind (Salisbury, 1961). Parts of the seedhead adhere to animals but seeds also survive digestion by stock animals (Campbell & Delfosse, 1984). Seeds have been found in animal droppings (Robinson, 1990). The gelatinous seed coat may aid further dispersal by animals (Crompton *et al.*, 1988).

Vegetative regeneration is by the production of axillary shoots from the base of the plant. This results in limited lateral spread. In shallow soils, new plants may develop from rhizomes at some distance from the parent. Detached roots and rhizome pieces are able to regenerate if soil conditions remain moist.

Management

Perforate St John's-wort cannot withstand cultivation and is not usually a problem in cultivated crops (Robinson, 1990). It is readily controlled by tillage and rarely invades properly managed pasture (Crompton *et al.*, 1988).

The sap of St John's-wort is acrid and grazing animals will usually avoid the plant (Mitich, 1994). Sheep will graze young plants when forage is scarce. In pasture, cutting and pulling promotes regrowth from the rhizome system. Cutting has little beneficial effect unless repeated at 2-week intervals (Campbell & Delfosse, 1984). Mowing and grazing reduce seed production but promote vegetative spread (Crompton *et al.*, 1988). Cultivating and resowing pasture will give control if the weed is left to desiccate on the soil surface. Perforate St John's-wort is tolerant of and even favoured by burning and may occur on burned areas of grassland (Grime *et al.*, 1988). Burning results in an increase of plant density (Campbell & Delfosse, 1984). Fire may stimulate seed germination (Crompton *et al.*, 1988).

In the UK, larvae of the gall midge, *Zeuxidiplosis giradiana* may prevent seed production (Salisbury, 1961). It is a small insect that lays eggs in the growing points of the plant (Campbell & Delfosse, 1984). When the larvae emerge they cause galls by feeding on the terminal shoots which reduces seed production. After its release in South Africa the gall midge proved valuable in damaging seedlings in moist habitats (Mitich, 1994). However, although *Z. giradiana* has become widely established in Australia its effect on the weed is not significant (Delfosse & Cullen, 1982).

The flea beetle, *Chrysolina quadrigemina*, has been used as a biological control agent against perforate St John's-wort (Van Emeden, 1970). The larval and adult stages feed on the foliage in spring and early summer but the larvae cause the most damage in the autumn and winter (Zimdahl, 1993). In Australia, infestations can result in complete defoliation of the host-plants (Campbell & Delfosse, 1984). After mating, the insects lay eggs on the underside of the leaves. Feeding takes place mostly at night. In Canada, the use of this and the related *C. hyperici* has met varying success (Zwölfer, 1970). Both beetles became established after release and were successful in reducing the weed. The habitat was important in the build up of the beetle populations. In California, there was a major improvement in pastureland following the introduction of *C. quadrigemina* (McLaren, 1993). In Australia, *C. quadrigemina* was the only one of 8 European insect species released that had a

significant effect in reducing common St John's-wort numbers (Delfosse & Cullen, 1982).

Various moth species have been evaluated as control agents in Australia (Campbell & Delfosse, 1984). Larvae of *Agrilus efformata* introduced from southern France have been shown to defoliate perforate St John's-wort.

Perforate St John's-wort is also attacked by various fungi (Crompton *et al.*, 1988).

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