The biology and non-chemical control of Common Field-speedwell (*Veronica persica* Poiret.)

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Common field-speedwell

(buxbaum's speedwell, bird's eye, cat's eyes, cuckoo's leader, large field-speedwell, Persian speedwell)

***Veronica persica* Poiret**

(*V. areolata, V. byzantina, V. buxbaumii* Ten., *V. hospita, V. tournefortii*)

Occurrence

Common field-speedwell is a decumbent winter to summer annual weed recorded on cultivated land throughout the UK. A native of SW Asia, it was first recorded in Europe around 1800 and Britain in 1825 (Clapham *et al*., 1987; Stace, 1997). By 1870 it was described as pretty frequent in England and southern Scotland (Salisbury, 1961). Within 50 years of being recorded it became the commonest speedwell and one of the commonest annual weeds in the UK (Salisbury, 1962a). It has also become a common garden weed (Copson & Roberts, 1991). It was probably introduced and dispersed with clover and other crop seeds (Salisbury, 1961). It became a common colonist in cornfields (Long, 1938). In an early survey of Bedfordshire and Norfolk it was found on all types of soil including chalk (Brenchley, 1913). Common field-speedwell prefers nutrient-rich loams (Hanf, 1970). It is most frequent on soils of pH 6.0 to 8.0 (Grime *et al.,* 1988). It is not recorded above 1,000 ft in Britain (Salisbury, 1961).

In a survey of weeds in conventional cereals in central southern England in 1982, common field-speedwell was found in 3, 2 and 4% of winter wheat, winter barley and spring barley respectively (Chancellor & Froud-Williams, 1984). It was relatively common in a survey of weeds in spring cereals in N E Scotland in 1985 (Simpson & Carnegie, 1989). In conventional winter oilseed rape surveyed in central southern England in 1985, common field speedwell was found in 3% of the crops (Froud-Williams & Chancellor, 1987). It has been shown to be a moderately competitive weed in this crop (Lutman *et al.,* 1995). Common field-speedwell was one of the most frequent weed species present in conventional sugar beet crops surveyed in East Anglia in autumn 1998 (Lainsbury *et al.,* 1999). It was also the most common species occurring in the field margins. In a study of seedbanks in some arable soils in the English midlands sampled in 1972-3, common field-speedwell was recorded in 78% of the fields sampled in Oxfordshire and 56% of those in Warwickshire (Roberts & Chancellor, 1986). Seeds were found in less than 1% of arable soils in a survey in Scotland in 1972-1978 (Warwick, 1984). In a seedbank survey of arable fields in France in 1983-85, common field-speedwell was common in the seedbank and relatively more frequent in the standing vegetation (Barralis & Chadoeuf, 1987).

In the past there was much discussion on the correct Latin name for common field speedwell (Lacaita, 1917). There is therefore some confusion in the early literature on the identity of the species.

Biology

Common field-speedwell flowers throughout the year and is self-fertile (Salisbury, 1961). The flowers are visited by insects but are often self-pollinated. Seed is set mainly from June to October but common field-speedwell can be found in fruit throughout the year (Grime *et al.,* 1988; Salisbury, 1962b). There may be 2 generations in one season. Average seed number per plant is given as 2,000 but a large plant may produce 5,000 to 7,000 seeds. However, Hanf (1970) suggests there are just 50-100 seeds per plant. The seed number per capsule is 7-18 and the 1,000 seed weight is 0.426g (Kelley, 1953). Seed rain from plants that emerged following cultivation in April extended from July to November (Legiuzamón & Roberts, 1982. Seed numbers in soil increased from an initial 1,720 to a final 37,580 per m^2 within the upper 10 cm of soil.

However, the germination of fresh seed is not promoted by light (Wesson & Wareing, 1969). In Petri dish tests with seed maintained under high or low light intensity or in darkness, seed germinated completely in the light but there was only 67% germination in the dark (Grime & Jarvis, 1976). In other studies there was 67% germination at alternating temperatures under a 'safe' green light but only 12% in complete darkness (Grime *et al.,* 1981). There was no germination at a constant temperature in the dark. Germination is increased by a period of dry-storage (Grime *et al.,* 1988). In the field, common field-speedwell germinates mainly from March to May (Salisbury, 1961). Seed sown in a 75 mm layer of soil in pots sunk in the field and stirred periodically, emerged from February to November with peaks in May and September (Roberts, 1964). Seed sown outside in boxes and pots of soil, cultivated or not, emerged in winter when sown on the surface or at 25 mm without cultivation (Froud-Williams *et al.*, 1984a). Seed sown at 75 mm and cultivated in February gave little germination. If cultivated in June emergence was mainly in the autumn. The optimum emergence depth was 5 to 20 mm and the maximum depth was 50 mm. Seed sown on the soil surface gave 43% germination, those sown at 25 mm gave 31% germination (Froud-Williams *et al.,* 1984b). Seeds gave the greatest germination when exhumed in autumn and the least when exhumed in summer. Seedling emergence in Scotland recorded in field plots dug at monthly intervals began in May and continued through until October with peaks in June or August (Lawson *et al.,* 1974).

In the field, 85-100% of seedlings emerged from the surface 30 mm of sandy and clay soils with the odd seedling emerging from down to 60 mm (Chancellor, 1964). In a sandy loam soil, field seedlings emerged from the top 50 mm of soil with the majority of these coming from the upper 20-30 mm (Unpublished information). Seedlings from deeper in the soil take several days longer to emerge than ones from shallower layers adding to the spread of emergence. Seedling emergence declines with increasing depth of seed burial (Grundy *et al.,* 1996). When seeds were buried in discrete layers at 6, 19, 32, 57, 108 and 210 mm most seedlings emerged from the top 50 mm of soil. When the seeds were distributed through the soil down to the different depths, seedling emergence was spread further down the soil profile. Seedlings are frost tolerant (Salisbury, 1962b).

Persistence and spread

Seed recovered from excavations and dated at 20 years old was reported to have germinated (Ødum, 1974). Seeds mixed with soil and left undisturbed had declined by 67% after 6 years but in cultivated soil the decline was 99% (Roberts & Feast,

1973). Seedbank decline was studied in a succession of autumn-sown crops (winter wheat & winter OSR) in fields ploughed annually for 3-4 years with seed return prevented (Wilson & Lawson, 1992). The annual rate of seed loss was 46% and the time to 99% decline was estimated at 6.1 years. Annual seedling emergence in any one year represented 4% of the seedbank. When the decline of seeds under a grass sward was monitored after 1, 2, 3, 19 and 20 years, common field speedwell showed a mean annual decline of 18% and a half-life of 3.5 years (Chancellor, 1986).

Common field-speedwell roots at the stem nodes, and broken off fragments are said to root readily when scattered by cultivation (Salisbury, 1962a). It has been shown to root from the basal region of stem fragments in the laboratory (Harris & Lovell, 1980).

Common field-speedwell seed is spread chiefly as an impurity in crop seed, manure and in fodder (Salisbury, 1961). In the period 1978-1981, it was found in 2-5% of wheat and 2-5% of barley seed samples tested at the Official Seed Testing Station (Tonkin, 1982). In grass seed of English origin tested in 1960-61, common field-speedwell was found in 2.8 to 38.6% of samples of the different cultivated grasses (Gooch, 1963). In grass seed of English origin common field-speedwell seed was found in 4.6% of samples tested of perennial and 3.2% of Italian ryegrass seed, 4.5% of meadow fescue, 3.0% of tall fescue and 1.4% of Timothy. Ants may transport the seeds (Grime *et al.*, 1988). Earthworms ingested 66% of common field speedwell seeds offered in laboratory tests and 67% of these were recovered in wormcasts (McRill, 1974).

Management

The best means of control are surface harrowing of cereal crops in spring, and the inclusion of root crops in the rotation (Long, 1938; Morse & Palmer, 1925). Only clean crop seed should be sown.

Seed numbers in soil were not reduced by fallowing for 1 year and only slightly reduced if the fallow was extended for a further year (Brenchley & Warington, 1933). In winter wheat over a similar period, seed numbers increased steadily. Fallowing every 5 years over a 15-year period did not reduce seed numbers in soil at the first fallowing period. However, in subsequent fallow years seed numbers were reduced progressively by 62% and 78% (Brenchley & Warington, 1945). It is uncertain why the effect was delayed. Plants are able to flower and set seed in the stubble after harvest and can emerge in autumn to flower and set seed before the spring cultivations (Brenchley & Warington, 1936). Seed numbers increased again in the first crop after fallowing.

Growth of common field-speedwell is strongly suppressed in shade (Grime *et al.*, 1988). In winter wheat, crop density is an important factor in limiting seed production by common field-speedwell through its effect on weed weight (Wright, 1993). Seed production may be halved as cereal density is increased from 60 to 195 plants per m^2.

In studies of the effect of heat treatments on seeds, imbibed seeds in trays of moist soil held at 75 or 100^{o}C lost viability after 12 hours (Thompson *et al.*, 1997). At 56^{o}C the results were variable and seed viability was reduced by 78-96% after 0.5 to 16

days. Seeds held at 155 or 204°C for 7.5 minutes or at 262°C for 5 minutes were killed.

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