The biology and non-chemical control of Ivy-leaved Speedwell (*Veronica hederifolia* L.)

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Ivy-leaved speedwell

(bird's eye, botherum, corn speedwell, dotherum, hen-bit, ivy chickweed, morgeline, mother of wheat, winter-weed)
***Veronica hederifolia* L.**
(*V. hederaefolia*)

Occurrence

A native, prostrate annual common in cultivated ground throughout the UK (Clapham *et al*., 1987). It is not recorded above 1,250 ft (Salisbury, 1961). In early surveys of Bedfordshire, Hertfordshire and Norfolk, ivy-leaved speedwell was chiefly associated with light sandy loams, but was also characteristic of clays. It was not recorded from gravel and was rarely seen on chalk (Brenchley, 1911; 1913). Ivy-leaved speedwell is an indicator of nutrient-rich loams (Hanf, 1970).

It is a common garden weed (Copson & Roberts, 1991). As an arable weed it showed a preference for winter wheat on heavy land (Brenchley & Warington, 1930). Ivy-leaved speedwell seed was found in 7% of arable soils in a seedbank survey in Scotland in 1972-1978 (Warwick, 1984). In a seedbank survey of arable fields in France in 1983-85, ivy-leaved speedwell was common in the seedbank but relatively more frequent in the standing vegetation (Barralis & Chadoeuf, 1987).

Two subspecies occur, ssp. *lucorum* with smaller lilac flowers is found mainly in gardens and shady places, ssp. *hederifolia* with larger blue flowers is found in open ground, cultivated fields and by roadsides (Stace, 1997). Tricotyledonous seedlings occur occasionally in the ratio of 1 in 1000 (Brenchley & Warington, 1936).

Biology

Ivy-leaved speedwell flowers from March to June or possibly even into August (Long, 1938). Seed number per plant is given as 200 by Hanf (1970). The average number of seeds per plant is 40 to 400 according to Salisbury (1962). There can be 1,200 seeds per plant in natural vegetation but in winter cereals this is reduced to 450 (Clarke *et al.*, 1995). There are 2 seeds per capsule and the 1,000 seed weight is 0.800 g (Kelley, 1953). It can be found in fruit for 5 months of the year. Seed production is closely correlated with both the fresh and dry weight of plants (Gerowitt, 1993).

Ripe seeds shed in June were dormant but after 1-2 months of burial outdoors there was germination in the laboratory at low constant or alternating temperatures of 4-15^{o}C but not at higher temperatures. In the field at this time, soil temperatures were still too high for germination. Seed sown in pans of field soil emerged in autumn with no germination in spring or summer (Brenchley & Warington, 1930). In field conditions, seedling emergence began in mid-October and continued into May with the odd seedling emerging from June to September (Roberts & Lockett, 1978). Seed sown in a 75 mm layer of soil in cylinders sunk in the field and stirred periodically

emerged from October to May (Roberts, 1964). The majority of seedlings emerge from 1st October to 31st December (Horne, 1953). Seedling emergence in Scotland recorded in field plots dug at monthly intervals occurred in April-May and September-October (Lawson *et al.*, 1974). Ivy-leaved speedwell seeds lose dormancy at high summer temperatures while low temperatures later in the year induce secondary dormancy (Karssen, 1980/81). The seeds have a low temperature for germination (2-12°C). Temperatures above 10°C promote after-ripening of fresh seeds and overcome dormancy in seeds buried in the soil (Roberts & Nielson, 1982). This ensures seeds are ready to germinate in autumn. Low temperatures over winter gradually re-impose dormancy in non-dormant seeds and germination ceases between June and September. Seeds naturally-occurring in field soil concentrated down by washing and put into dishes, germinated best in conditions where temperature fluctuations were around 16°C in the light (Warington, 1936). In fluctuations of less than 1°C in subdued light germination was 80% lower. Transfer to the wider fluctuating temperatures in August resulted in increased germination beginning in September. Modelling emergence against meteorological data suggests that temperature is the dominant factor in determining an emergence event (Grundy *et al.*, 1999). The probability of emergence decreases with an increase in the maximum weekly temperature. Soil moisture is only important once the temperature requirement is met.

In the field, 83-100% of seedlings emerge from the top 70 mm of soil with the odd seedling emerging from down to 130 mm. Emergence in autumn and early winter tends to be from shallower depths than in spring (Chancellor, 1964). In sandy loam soil, field seedlings emerged from the top 110 mm of soil with the majority evenly spread between 5 and 60 mm. Very few seedlings emerged from the surface 0-5 mm (Unpublished information). In a clay loam soil, field seedlings in November emerged from the upper 90 mm of soil with most seedling emergence evenly spread down to 60 mm.

Persistence and Spread

Seed longevity in soil is 3-4 years (Guyot *et al.*, 1962). Seeds mixed with soil and left undisturbed had declined by 65% 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 57% and time to 99% decline was estimated at 5.4 years. Annual seedling emergence in any one year represented 2% of the seedbank. The decline of seeds under a grass sward was monitored after 1, 2, 3, 19 and 20 years (Chancellor, 1986). Ivy-leaved speedwell showed a mean annual decline of 19% and a half life of 3.5 years.

Some *Veronica* species are able to root from stem fragments but this rarely happens with ivy-leaved speedwell (Harris & Lovell, 1980). Seed is found in cattle droppings (Salisbury, 1961).

Management

Control is by surface cultivations in spring (Long, 1938). Cereals should be harrowed well early in the season and root crops kept clean by inter-row cultivations (Morse & Palmer, 1925). Only pure crop seed should be sown.

In winter wheat, ivy-leaved speedwell can affect ear number and yield at a high weed density (Angonin *et al.*, 1996). The weed has a shorter life cycle than winter wheat and after rapid initial development, growth ceases at around the 1st node stage of the crop (Angonin, 1993). However, ear and grain numbers, but not the thousand grain weight, are determined before the stage that the weed ceases growth. In conventional winter wheat, an early nitrogen fertilizer application benefits the weed while a later application favours the crop. The weed is also favoured by poor crop establishment (Gerowitt, 1993). Ivy-leaved speedwell germinates primarily in autumn-winter and has been found to gradually disappear following a series of spring cereals (Rademacher *et al.*, 1970).

Seed numbers in soil were reduced by fallowing for 1 year and the reduction was greater if the fallow was extended for a further year (Brenchley & Warington, 1933). The land was ploughed, disked and harrowed during this time. Seed shedding early in the year may have prevented a greater reduction in seed number. There was a similar steady reduction in seed numbers during cropping with winter wheat over the same period. Early cultivations prevented most of the weeds seeding. Fallowing at 5 year intervals over a 15 year period did not consistently reduce seed numbers in soil (Brenchley & Warington, 1945). The level of success depends on the prevailing weather conditions and timing of cultural operations during the cropped years.

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