The biology and non-chemical control of Wall Speedwell (*Veronica arvensis* L.)

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Wall speedwell
(Corn speedwell)
***Veronica arvensis* L.**

Occurrence
Wall speedwell is an erect, native winter or more rarely summer annual. It is found on walls, banks, open acid or calcareous ground and cultivated soils (Stace, 1997). It is common on grassland and heaths usually on dry soils throughout the UK (Clapham *et al*., 1987). In early surveys of Bedfordshire, Hertfordshire and Norfolk it occurred chiefly on lighter soils but was rare on chalk (Brenchley, 1911; 1913). It is a relatively common garden weed (Copson & Roberts, 1991). Wall speedwell prefers nutrient-rich, moderately acid, loose loams or sandy loams (Hanf, 1970). It is found mainly on soils in the pH range of 6.0 to 8.0 (Grime *et al.*, 1988). It is recorded up to 2,700 ft in Britain (Salisbury, 1961).

Wall speedwell was plentiful in autumn-sown wheat (Brenchley & Warington, 1930). But was less frequent in oats (Brenchley, 1920). In a survey of weeds in conventional cereals in central southern England in 1982, wall speedwell was found in 2% of winter wheat and winter barley but not at all in spring barley (Chancellor & Froud-Williams, 1984). In a comparison of the ranking of arable weed species in unsprayed crop edges in the Netherlands in 1956 and in 1993, wall speedwell had moved up from 23rd to 12th place (Joenje & Kleijn, 1994). In a study of seedbanks in some arable soils in the English midlands sampled in 1972-3, wall speedwell was recorded in 94% of the fields sampled in Oxfordshire and 31% of those in Warwickshire (Roberts & Chancellor, 1986).

Tricotyledonous seedlings occur at the rate of 1 in 20,000 (Brenchley & Warington, 1936).

Biology
Wall speedwell flowers from April to May (Hanf, 1970), or March to October (Clapham *et al*., 1987). Plants require vernalization and long days to stimulate flowering (Grime *et al.*, 1988). Seed is set from June onwards. Wall speedwell has around 18 seeds per capsule (Salisbury, 1961). The average seed number per plant is 611 (Pawlowski *et al.*, 1970). There are 17,000 seeds on a large plant (Grime *et al.*, 1988). The 1,000 seed weight is 0.090 g (Kelley, 1953).

Most freshly-shed seeds have an after-ripening requirement (Grime *et al.*, 1988). In the laboratory, germination is increased by a period of dry-storage. Seed sown in pans of field soil emerged chiefly in the autumn soon after sowing and in the winter (Brenchley & Warington, 1930). Most seed had germinated within 2 years. Seed sown in a 75 mm layer of soil in cylinders sunk in the field and stirred periodically, emerged in two main flushes, April to May and August to November (Roberts & Boddrell, 1983). Odd seedlings emerged at other times too. Most seeds germinated in the first 3 years of the experiment and few viable seeds remained by year 5. Seed

germination is prevented by low soil moisture levels and high temperatures. It is this combination that limit seedling emergence in summer (Grime *et al.,* 1988). Germination is also inhibited by shading and darkness. Seed that had been stratified in soil overwinter gave 56 to 91% germination in the light and 3 to 15% in darkness with a 5 second flash of light but there was no germination in complete darkness (Andersson *et al.,* 1997).

Dry-stored seed kept at ambient temperature for 1 to 15 weeks had an optimum germination temperature of 10^{o}C after 5 weeks and required light for germination (Janssen, 1973). The optimum temperature increased with seed age to 20^{o}C after 15 weeks and light was not required for germination. The rate of germination also increased with seed age. In laboratory tests, germination was substantially increased when seeds were transferred from darkness to daylight (Froud-Williams *et al.,* 1984b).

Seed sown outdoors at different depths in pots with and without cultivation emerged mainly in winter when left on the soil surface (Froud-Williams *et al*., 1984a). Seed at 25 mm depth without cultivation gave lower germination but emerged over a longer period. Seed sown at 75 mm gave little germination when cultivated in February but emerged in the autumn when cultivated in June. In a second experiment, seed on the soil surface germinated in winter and spring. Seed sown at 50 mm deep gave little germination whether cultivated or not. The optimum depth of emergence was 0-5 mm and the maximum was 10 mm. Seed sown on the soil surface gave 61% germination seed sown at 25 mm gave none (Froud-Williams *et al.,* 1984b). 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.

In the USA, freshly mature seed is generally dormant (Baskin & Baskin, 1983). During the summer the seeds after-ripen and the proportion and rate of germination increase. The temperature range over which germination will take place widens but light is still required. The seeds will germinate in the autumn but not if temperatures are high. Germination will also occur in spring.

Seedlings are frost tolerant (Salisbury, 1962).

Persistence and Spread

Wall speedwell seeds form a persistent seedbank. Seed recovered from excavations and dated at 30 years old was reported to germinate (Ødum, 1974). The annual percent decline of seeds in cultivated soil was 58% (Popay et al., 1994).

Seeds are buoyant in air streams and local wind dispersal can occur (Grime *et al.,* 1988). Seed has been found in cattle droppings (Salisbury, 1961).

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Management

Only pure crop seed should be sown. To deal with this taprooted weed, cereals should be harrowed well early in the season and root crops kept clean by inter-row hoeing (Morse & Palmer, 1925). Stem pieces root readily but this is not seen in the field (Grime *et al.,* 1988).

Seed numbers in soil were reduced by 50% after a 1-year fallow and by 80% if the fallow was continued for a second year (Brenchley & Warington, 1933). Cropping with winter wheat for the same period increased seed numbers in year 1 but numbers returned to the original level in year 2. Seed return is obviously dependent on seedling survival under the different conditions each year. Fallowing at 5-year intervals over a 15-year period reduced seed numbers in soil but not consistently (Brenchley & Warington, 1945). Seed numbers were 260%, 137% and 33% of original levels after the different fallow years but seed numbers increased sometimes in the intervening cropped years.

In winter wheat, crop density is an important factor in limiting seed production by wall speedwell through its effect on weed weight (Wright, 1993). Seed production may be halved as crop density is doubled up to 200 crop plants per m^2. Unlike many broad-leaved weeds, wall speedwell did not appear to decline following a change to direct drilling and minimum cultivation techniques in cereals (Makepeace, 1982).

The seeds of wall speedwell are consumed by several species of ground beetle (Tooley *et al.*, 1999).

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