The biology and non-chemical control of Pale Persicaria (*Persicaria lapathifolia* (L.) Gray)

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Pale persicaria

(pale-flowered persicaria, pale smartweed)
***Persicaria lapathifolia* (L.) Gray**
(*Polygonum lapathifolium* L., *P. tomentosum*)

Occurrence

Pale persicaria is a native annual that occurs in waste places and cultivated ground especially on damp soils (Clapham et al., 1987). It also occurs in ditches, manure heaps, on river gravels and by ponds (Lousley & Kent, 1981). It is found throughout Britain on a range of soils but is perhaps less common in the north (Simmonds, 1945). It is sometimes troublesome on moist arable soils in good condition (Long, 1938). In an early survey of Bedfordshire and Norfolk, pale persicaria was often confined to light sandy soils but was sometimes dominant on clay (Brenchley, 1913). It was often found in the damper parts of a field. Drought causes poor growth. Pale persicaria is not recorded above 1,250 ft in Britain and has been found in prehistoric deposits (Salisbury, 1961). It has been classed as a 'follower of man' with no natural habitat. Pale persicaria can occur as a birdseed alien (Hanson & Mason, 1985).

In a survey of weeds in conventional cereals in central southern England in 1982, pale persicaria was found in 2, 1 and 2% of winter wheat, winter barley and spring barley respectively (Chancellor & Froud-Williams, 1984). It was a common weed in a seedbank survey in swede turnip fields in Scotland in 1982 (Lawson *et al.,* 1982). It was found in 47% of fields sampled but never in high numbers. In a comparison of the ranking of arable weed species in unsprayed crop edges in the Netherlands in 1956 and 1993, pale persicaria moved from 19th to 22nd (Joenje & Kleijn, 1994). In a series of 4 national weed surveys made in Hungary between 1950 and 1997, pale persicaria moved from 29th to 15th place in the rankings (Tóth *et al.,* 1999; 1997).

Pale persicaria is very variable in habit, flower colour and pubescence (Stace, 1997). It shows great plasticity in height, growth habit, branching and leaf shape. Many varieties have been described with greenish white, red or pink flowers (Simmonds, 1945). Several hybrids with related species have been recorded.

Pale persicaria seeds appear to have been collected and used for food in the Iron Age (Mitich, 1998).

Biology

Pale persicaria flowers from June to September (Simmonds, 1945), or July to August (Long, 1938), or June to October (Lousley & Kent, 1981). Emergence to flowering may take around 6 weeks. The flowers are self-pollinated or cross-pollinated by insects (Mitich, 1998). Seed numbers per plant range from 10 to 1,500, and 825 to 19,300 according to different authors (Stevens, 1957). In cereal crops and winter rape the average seed number per plant ranged from 30 to 123 and in root crops from 986 to 1,134 (Pawlowski, 1966). The 1,000 seed weight from various authors ranged

from 0.80 to 3.60 g (Stevens, 1932). Seed from different sources demonstrated considerable variation in seed weight both between and within populations and even between inflorescences on the same plant (Hammerton, 1967). Improved levels of mineral nutrition increased plant weight, seed production, seed weight, and seedling emergence was greater from the heavier seeds (Hammerton & Nuttall, 1971). The time from emergence to seed set is 30 to 55 days.

Pale persicaria germinates in spring. The seeds require a period of after-ripening at low temperature before germination will occur (Simmonds, 1945). Seed was dormant when shed and for 60 days after according to Justice (1941). Scarification, exposure to low winter temperature and stratification at 2-4^{o}C for 8 weeks increased germination levels but not when there was strong innate dormancy (Staniforth & Cavers, 1979). Dormancy is overcome by low winter temperatures and re-imposed when temperatures increase in late spring. Just a short period at a high temperature may be sufficient to impose dormancy. Seed stratified outdoors in soil overwinter was exhumed and tested for germination in the light, in the dark and in the dark with a 5 second flash of light (Andersson *et al.,* 1997). Seed gave 71 to 82% germination in the light, 37-55% germination in the dark with a short flash of light and 15-30% germination in complete darkness.

Freshly collected seeds mixed into the surface 75 mm of soil in cylinders sunk in the field and stirred periodically, emerged from April to May with a peak in April (Roberts & Neilson, 1980). Most seedlings emerged in the first year of the 5-year trial then there was a gradual decline to year 5.

In Sweden, pale persicaria is considered a summer annual (Håkansson, 1979). Seeds mixed with soil in the autumn, put in frames in the field, exhumed at intervals and put to germinate at alternating temperatures showed the seeds to have the lowest dormancy and greatest tendency to germinate from March to May. Some seedlings emerged in the autumn after sowing.

In the field 83-98% of seedlings emerged from the surface 40 mm of sand, clay and peat soils with the odd seedling from down to 80 mm (Chancellor, 1964). Emergence is better from 10 or 30 mm depth than from the soil surface.

Adventitious roots may develop on the lower nodes of stems in contact with the soil (Simmonds, 1945).

Persistence and Spread

The decline of seeds broadcast onto the soil surface and then ploughed in was followed over a 6-year period of cropping with winter or spring wheat grown on a clay and a silty loam soil. Every effort was made to prevent further seed return to the soil. Pale persicaria had a mean annual decline rate of 22% and an estimated time to 95% decline of 10-17 years (Lutman *et al.*, 2002). Seed buried at 20 cm deep in soil gave 10% germination after 2.5 years but most viability was lost after 4.5 years. Seed submerged in water retained 59% viability after 5 years (Comes *et al.,* 1978). Seed in dry storage gave 42% germination after 3 months and the same after 4 years. In other studies, dry storage reduced viability by around 50% after 4 years and 100% after 7 years (Simmonds, 1945).

Seeds of pale persicaria are eaten by birds (Simmonds, 1945) and seedlings have been raised from bird excreta (Salisbury, 1961). The seeds are also eaten and spread by rabbits (Mitich, 1998). Seed has been found in cattle droppings. The period and depth of burial in dung affects seed viability (Simmonds, 1945). Greater depth and increased duration of burial from 2 weeks to 2 months reduced viability to 1%.

In Canada, the seeds are dispersed by water and by cottontail rabbits (*Sylvilagus floridanus*) (Staniforth & Cavers, 1977). Dispersal by cottontails follows passage through the digestive system and deposition in faecal pellets at some distance from the feeding site. In feeding studies most seeds emerged within 2-8 hours of digestion, although some continued to emerge for up to 48 hours. Around 4.5% of seeds are viable after digestion.

Pale persicaria seed has been found as an impurity in clover and grass seed (Simmonds, 1945). In red clover seed from Europe, an average of 25 weed seeds per 1,000 clover seeds has been recorded which would result in 78,000 weed seeds sown per acre or 19 per m^2. In cereal seed samples tested in 1961-68, pale persicaria was found in up to 2.0% of rye, 3.7% of oats, 4.9% of barley and 3.4% of wheat samples tested (Tonkin, 1968). In cereal seed sampled in the period 1978 to 1981, pale persicaria seed was found in up to 7% of wheat and up to 12% of barley samples tested (Tonkin, 1982). In a survey of weed seed contamination in cereal seed in drills ready for sowing on farm in spring 1970, pale persicaria seed was found in 6% of samples (Tonkin & Phillipson, 1973). Most of this was home saved seed. In a survey of weed seed contamination in 1960-61, pale persicaria was found in 2 to 6% of vegetable brassica and 4% of carrot seed samples tested (Gooch, 1963).

Seeds have been recovered from irrigation water in the USA (Kelley & Bruns, 1975; Wilson, 1980). Seeds float for 1 day in water (Simmonds, 1945). Seeds with the perianth intact may float for 6 months in still water but sink within 84 hours in agitated water (Staniforth & Cavers, 1976). In reclaimed bog in Ireland, debris cleared from drainage channels and spread on the field contained viable pale persicaria seeds together with seeds of other species (MacNaeidhe & Curran, 1982).

Management

Control is by surface cultivations in spring and early summer and the inclusion of hoed root crops in the rotation (Long, 1938). Seeding must be prevented.

Exposure to an arbuscular-mycorrhizal fungal inoculum has been shown to cause a 60% reduction in biomass in pale persicaria, a non-host weed species (Jordan *et al.*, 2000).

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