

The biology and non-chemical control of Field Penny-cress (*Thlaspi arvense* L.)

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Field penny-cress

(Boor's mustard, bowyer's mustard, churl's mustard, dish mustard, mithridate mustard, treaclewort)

***Thlaspi arvense* L.**

Occurrence

An annual or overwintering plant, doubtfully native, sometimes plentiful on arable land. It is also frequent on disturbed and waste ground, and roadsides (Clapham et al, 1987). Field penny-cress is scattered over most of the UK but commoner in England (Stace, 1997). It is frequent in S & E England and scarcer in the W & N (Rich, 1991). In a preliminary survey of arable weeds in the 1970s it was absent or rare in most of the areas studied but was common to frequent in 11% of them (Chancellor, 1977). It is not recorded above 1000 ft in the UK (Salisbury, 1961). Early and late flowering forms have been reported (Best & McIntyre, 1975). It is able to adapt to a range of environmental conditions and succeeds in both dry and wet habitats.

The seeds contain a glucoside that breaks down to form a mustard oil that can cause poisoning in stock (Best & McIntyre, 1975). Germination was inhibited in lettuce and cress seed treated with an extract of pulverised penny-cress seeds (Wagenvoort & Van Opstal, 1979). The plant smells strongly when crushed and taints the milk of cows that eat it. The meat from animals that have eaten the weed is also tainted (Morse & Palmer, 1925).

Biology

An annual or overwintering weed forming a compact vegetative rosette, field penny cress flowers from (March) May to October and is self pollinated. Seedlings that emerge in the autumn overwinter as a rosette and flower early in the growing season. Stem elongation occurs with the onset of flowering (Best & McIntyre, 1975). The fruit is compressed and broadly winged. There are 3-8 seeds in each of the 2 locules (Rich, 1991). Field penny-cress has approximately 12 seeds per pod and 20,000 seeds per plant (Long, 1938). Salisbury (1961) gives the average seeds per pod as 16 and the average seeds per plant as 2000. Stevens (1932) gives the average seeds per plant as 7,040, Stevens (1957) quotes 900 to 2000 seeds per plant while Best & McIntyre (1975) suggest a single plant will produce 1,600 to 15,000 seeds. The range of 1000 seed weights given by different authors varied from 0.785 to 1.750 g (Stevens, 1932). Plant size and branching habit is enhanced and flowering delayed by increasing nitrogen levels (Best & McIntyre, 1975). Seed production is also likely to increase. Flowering is hastened by increasing temperatures. Spring seedlings may flower within 30-50 days of emergence and produce seed by early July. In cereals, field penny-cress seeds mature and shed before grain harvest.

Seed is shed over several weeks (Best & McIntyre, 1975). It is said that fresh seed will germinate in the light with adequate moisture and alternating temperatures. In lab tests, there was good germination at alternating temperatures of 10-25°C in the light. Scarification of the seed coat promotes germination. Seeds can become viable

6 days after flowering (Baskin & Baskin, 1989). In the USA, plants may behave as either summer or winter annuals. Plants from seeds that germinate in autumn overwinter as rosettes and flower in spring. Plants from seeds that germinate in spring flower and set seed later the same year. Seeds can after-ripen at low temperature and seeds produced in autumn after-ripen over the winter and germinate in early spring. Soil disturbance increases the level of germination because of light stimulation. In the USA, freshly matured seeds in May are dormant for a short period until after-ripening has occurred in summer. Seeds that are non-dormant in autumn become conditionally dormant or dormant at low winter temperatures.

In the laboratory, stored seed did not germinate under constant temperature with or without light. Even with alternating temperatures there was less than 10% germination (Wagenvoort & Van Opstal, 1979). Germination reached 50% when the seeds were treated with fertilizer solution and alternating temperatures and, following stratification for 2 days at 5°C, the level of germination increased further. Seed dormancy was overcome by chilling at between 5 and 15°C but light was still needed (Hartmann *et al.*, 1996). Without light, seeds gradually returned to a dormant state. The presence of nitrate was also important in making light stimulation more effective. It is suggested that spring cultivations should be made in unfertilised soil and that fertiliser application should be left until after crop and weed emergence.

Seed sown in a 7.5 cm layer of soil in cylinders sunk in the field and stirred periodically emerged from February to October with the main flush from February to June (Roberts, 1964). Substantial numbers of seeds germinated in the first 4 years from seed sown in trays of soil in the field but most emerged in year 1 (Chepil, 1946a). When seeds in trays of soil in the field were given different cultural treatments the highest percentage of germination was from seeds left on the soil surface (Chepil, 1946b). The deeper seeds were buried, the lower the number of emerged seedlings and the greater the number of seeds that survived to the end of the experiment. Periodic cultivations increased seedling emergence. In a sandy loam soil, field seedlings emerged from the top 50 mm of soil with most coming from the top 30 mm (Unpublished information).

Persistence and Spread

Seed exhibits a dormancy period in excess of 3 years (Chepil, 1946a). Seeds remain viable in soil for at least 8 years (Salisbury, 1961). Seeds have survived up to 10 years in soil and still given 87% germination. In cultivated soil though, few seeds survive longer than 6 years (Best & McIntyre, 1975). In Duvel's burial experiment, seed buried at 8, 22 and 42 inches gave 11, 8 and 12% germination respectively after 1 year, 34, 52 and 8% after 6 years, 0, 11 and 1% after 30 years and none after 39 years (Toole, 1946).

Seeds will float in water for 24 hours (Best & McIntyre, 1975). Dispersal is also by wind. Viable seeds have been found in pigeon droppings and seedlings have been raised from various bird excreta (Salisbury, 1961). Apparently viable seeds were found in samples of cow manure (Mt Pleasant & Schlather, 1994). Ensilage for 8 weeks, rumen digestion in cattle for 24 hrs or a combination of both seemed to kill field penny-cress seed but some still appeared viable (Blackshaw & Rode, 1991). With rumen digestion, there was a gradual loss of viability to 30% after 24 hrs in one test but in another 98% of seeds were still able to germinate after rumen digestion.

After 2 weeks of windrow composting at temperatures of 50-65 °C, penny-cress seeds were all killed (Tompkins *et al.*, 1998). Seed is killed when heated at 85 °C for 15 minutes in dry heat (Hopkins, 1936).

Management

It is important to prevent seeding by destroying plants when young with the harrow, cultivator and hoe (Morse & Palmer, 1925). Field penny-cress seedlings should be hoed off in root crops (Long, 1938). Germination should be encouraged by surface cultivation. Do not plough in seed bearing plants. Laying land down to a 3-4 year ley will choke out the weed.

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