

The biology and non-chemical control of Wild Radish (*Raphanus raphanistrum* L.)

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Wild radish

(jointed charlock, jointed radish, runch, white charlock, white weed)

***Raphanus raphanistrum* L.**

Occurrence

Wild radish is an annual or biennial weed that occurs on similar soils to charlock and is frequent on cultivated and rough ground, waste places and tips (Stace, 1997). It is doubtfully native but has been present since the Roman occupation and possibly since prehistoric times. There is evidence that wild radish was a weed of crops in the Iron Age (Greig, 1988). It is a troublesome weed especially of non-calcareous soils and is common throughout the UK. In early surveys of Bedfordshire and Norfolk it was a characteristic weed of chalk and sand (Brenchley, 1913). It can be very troublesome on non-calcareous soils (Chancellor, 1959). Wild radish prefers a nutrient rich, lime-free sandy or loamy soil according to Hanf (1970). It germinates freely in autumn and is a problem in winter cereals (Long, 1938) and also in spring ones (Hanf, 1970). In a survey of arable weeds in 1971-73, wild radish was common to abundant in 14% of the surveyed areas but was absent or rare in the majority (Chancellor, 1977). Wild radish occurs occasionally as a birdseed alien (Hanson & Mason, 1985).

Wild radish is a variable species and plants may differ in flower colour and fruit size and shape (Rich, 1991). Yellow and white flowered forms are found and others occur with white petals and violet veining (Clapham *et al.*, 1987). Different flower colour forms can be found in a single population. There is the potential for hybridisation between the wild radish and the cultivated radish, *R. sativus* (McNeill, 1976). There is also the potential for interspecific hybridization between wild radish and oilseed rape (Darmency *et al.*, 1995). This is of particular concern in relation to genetically modified oilseed rape.

Wild radish pods harvested and stored with lupin seed have caused a pronounced reductions in the germination of the lupin seed (Wood *et al.*, 1985). The radish pods release a toxin during storage that affects the viability of the crop seed. The compound is likely to be an isothiocyanate or mustard oil. The seeds are dangerous if eaten by stock (Morse & Palmer, 1925). It has always been believed that wild radish is harmful to stock if eaten in quantity but there are no recent records of this (Forsyth, 1968).

Biology

Wild radish flowers from May to September (Long, 1938), or possibly June to October (Rich, 1991). Seed set is often variable due to self-incompatibility and erratic pollination (Cheam & Code, 1995). Seeds within a pod may be the result of pollination by different plants so genetic differences may be present even in a single pod. The seed pods are indehiscent and break into segments containing a single seed. Each pod contain from 1 to 10 seeds. The average seed number per plant is 1,462 (Pawlowski *et al.*, 1970). The seed numbers per plant range from 150 to 200

according to Guyot *et al.* (1962). While Stevens (1957) gives the seed numbers per plant as 160 to 1,875 and the 1,000 seed weight as 7.65 g. For wild radish growing in a wheat crop, seed numbers per plant ranged from 67 to 1,030 depending on the density of the weed and the crop (Reeves *et al.*, 1981). In Australia, seed production was greater in seedlings that emerged earlier and there was a progressive reduction with later emergence (Cheam, 1986). Seedlings that emerged earlier also took longer to reach flowering. The time from germination to fruiting is around 100 days (Guyot *et al.*, 1962).

Freshly shed seed has a low germination level (Mekenian & Willemsen, 1975). Germination of seed in intact pods is less than that of isolated seeds due to both mechanical and biochemical inhibition (Murphy *et al.*, 1998). Leaching of seed with water increased germination probably due to the loss of an inhibitor. Light has only a slight effect on germination. Seeds germinate mainly in spring but are strongly dormant (Rich, 1991). Cultivation that leads to shallow burial of wild radish seed in moist soil stimulates germination (Cheam & Code, 1995). Plants that emerge earlier produce a greater percentage of dormant seeds (Cheam, 1986). In Australia, the level of dormancy differed between populations from separate regions and was under genetic control. It was found that the three major flower colour forms produce seeds with different levels of dormancy (Cheam & Code, 1995). Seeds of the white and purple-flowered forms are significantly more dormant than the yellow forms.

Field emergence in plots cultivated at monthly, 3 monthly or yearly intervals or not at all, extended from March to October with the main flush in March-May and a smaller peak in August (Chancellor, 1964b). The least number of seedlings emerged on the uncultivated plots. In plots dug into a grass sward and cultivated at monthly intervals, wild radish seedlings emerged from February to September with peak emergence from March to May (Chancellor, 1986).

In the field, the optimum emergence depth is 10 mm (Cheam & Code, 1995). Large seeds are more likely to emerge from 20 mm or deeper in the soil than small seeds but seed size has little effect on time of emergence. Seedlings from large seeds grow faster and mature into bigger plants that produce a greater numbers of seeds. In the field, 64 to 100% of seedlings emerged from the surface 40 mm of a sandy soil with the odd seedling from below this down to 70 mm (Chancellor, 1964a). In a sandy loam soil, field seedlings emerged from the upper 80 mm of soil with the majority in the top 20 mm but there was a reasonable spread of seedlings from the surface down to 50 mm deep (Unpublished information). Buried seeds emerged best from 10 mm deep, generally better than from surface sown seed (Reeves *et al.*, 1981). Much fewer seedlings emerged from 50 mm deep and hardly any at 100 mm. Seedling emergence was much greater in cultivated than uncultivated soils. The mean depth of emergence was significantly shallower on uncultivated land (Young & Cousens, 1998). The average depth of emergence in all soil conditions was 16 mm, the maximum was 75 mm but most seedlings came from the 0 to 50 mm layer.

Persistence and spread

Seed numbers in soil declined with time but the loss was much slower at 100 mm depth than with shallower burial (Reeves *et al.*, 1981). After 2 years there were still 53% of viable seeds remaining at 100 mm compared with 16% at 10 mm. The decline of seeds under a grass sward was monitored after 1, 2, 3, 19 and 20 years

(Chancellor, 1986). Wild radish showed a mean annual decline of 33% and a half life of 2 years. Cultivation enhances seedling emergence and reduces the seedbank (Murphy *et al.*, 1998).

Seed has been found in cattle and sheep droppings and in manure. Seedlings have been raised from bird excreta (Salisbury, 1961). Seed may be carried in soil on footwear and machinery (Cheam & Code, 1995). In a survey of weed seed contamination in 1960-61, wild radish seed was found in 3% of beet seed samples tested (Gooch, 1963). Wild radish seed also occurs as an impurity in cereal seed. In cereal seed samples tested in 1961-68 it was a frequent contaminant being found in up to 3.3% of rye, 1.5% of oats, 1.4% of barley and 0.5% of wheat samples tested (Tonkin, 1968). In a survey of weed seed contamination in cereal seed in drills ready for sowing on farm in spring 1970, it was found in 7% of samples (Tonkin & Phillipson, 1973). Most of this was home saved seed. If present in large numbers as an impurity, wild radish seeds can reduce the viability of crop seeds due to the toxic vapour that it gives off.

Management

Control is by avoiding the introduction of seed and by the mechanical destruction of seedlings (Morse & Palmer, 1925). In drilled cereals in the past horse hoeing was the recommended practice (Long, 1938).

While stubble cleaning may not be appropriate for dealing with the shed seeds of some weed species it can be an effective way of controlling some important weeds including wild radish. The surface soil should be cultivated to a depth of not more than 5 cm and this operation is then repeated at 14-day intervals (Donaldson, 1986). Germination is stimulated and the seedlings are then destroyed by subsequent cultivations, depleting the seed reserves in the soil. Deep cultivation that buries seed below 10 cm will reduce seedling emergence but a high percentage of the seed will remain viable. Subsequent cultivations need to be shallow to avoid bringing seed back to the surface. Seedling numbers increase with increasing depth and frequency of tillage (Pollard & Cussans, 1976). The presence of seeds having different levels of dormancy limits the success of fallowing treatments (Cheam & Code, 1995).

Over an 11 year period of cereal cropping (1962 to 1973) in one particular field, wild radish declined from being 5.4% of the weed population at 15 plants /m² to being just 0.7% at 1 plant/m² (Chancellor, 1976). This was due to a combination of herbicide use and fallowing that prevented seeding together with liming of the soil at 5 t/ha that raised the pH from 6.0 to 6.8.

Wild radish has a long taproot that enables it to resist moisture stress (Cheam & Code, 1995). The root provides adequate reserves for regrowth if plants are cut down or grazed off. Grazing is not recommended as a control measure because of the harm wild radish can do to stock.

Wild radish seed is susceptible to soil solarization. Small seedlings are susceptible to flame weeding but larger plants are not (Ivens, 1966).

Wild radish seedlings are attacked by flea beetles (*Phyllotreta* spp.) and can suffer severe damage in certain conditions but often there is just leaf pitting (Personal experience).

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