The biology and non-chemical control of Perennial Rye-grass (*Lolium perenne* L.)

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Perennial rye-grass

(English ryegrass, ray-grass, rye-grass)
***Lolium perenne* L.**

Occurrence

Perennial rye-grass is a tufted, fibrous rooted perennial grass that is generally regarded as native and is common throughout Britain (Beddows, 1967). The wide distribution may be a result of the once exclusive use of perennial rye-grass in the sowing of leys. It has been cultivated as a forage grass since the 17th century (Grime *et al.*, 1988). As a consequence of seed spread during transport of hay from the fields it became established along trackways and roads. It is a common escape from gardens, roadside plantings and pastures (Stace, 1997). It is a very frequent birdseed alien (Hanson & Mason, 1985). Perennial rye-grass prefers fertile soils, it is rare in upland pastures unless lime has been applied. It is at its best in old swards, on rich soil, under summer grazing management. Together with white clover it formed the traditional 'fattening' pastures. Most of these have disappeared with the increase in cereal growing. It continues to be an important constituent in grass seed mixtures for short, medium and long term leys. Perennial ryegrass is characteristic of grassland that has received some agricultural improvement and is often associated with heavily grazed short swards (Gibson, 1996).

In a survey of cereal weeds in central southern England in 1981-1982, perennial rye-grass was found in 2% of winter wheat and spring barley fields but less than 1% of winter barley fields (Chancellor & Froud-Williams, 1984). It is an increasing problem on some farms.

Perennial rye-grass can survive a period of immersion in seawater and withstands the effect of salt contaminated soil (Beddows, 1967). It can also withstand trampling (Grime *et al.*, 1988).

Perennial rye-grass shows great variation in growth-form from erect plants with few tillers to prostrate cushions with numerous shoots (Beddows, 1967). Variation in the form of the flowerhead is also common (Clapham *et al.*, 1987). Many different genotypes have been bred (Grime *et al.*, 1988). New generation perennial rye-grass cultivars are extremely fine-leaved allowing pure rye-grass swards to be used in sports turf. Natural hybrids with other grasses are known to occur.

Perennial rye-grass is relatively resistant to maceration when grazed by sheep (Derrick *et al.*, 1993). It is tough compared with broad-leaved plants and has a high fibrosity index (Wilman *et al.*, 1997). In feeding studies with sheep it was high in water soluble carbohydrate (Wilman & Derrick, 1994). Levels of N, P, K, Ca, Mg and Na were similar to or lower than many broad-leaved pasture species.

Biology

The first perennial rye-grasses to flower do so in May and flowering in the different cultivars continues throughout the summer (Beddows, 1967). Flowers are wind pollinated, the pollen travelling up to 180 m. Flowers are self-incompatible (Grime *et al.*, 1988). Limited self-pollination can occur but the progeny exhibit low vigour. Seeds ripen within 4-5 weeks of flowering and are viable from the 'dough' stage. Seeds can germinate immediately on shedding. High levels of nitrogen reduce the number of spikelets per inflorescence and hence the number of seeds but this is offset by an increased number of inflorescences (Naylor, 1984).

In Petri-dish tests with seed maintained under high or low light intensity or in darkness, seed germinated completely in all conditions (Grime & Jarvis, 1976). In further tests seeds germinated equally well in red, blue or green light and in darkness. Seed under high levels of far-red light did not germinate. Seeds had a high level of germination at alternating and constant temperatures in darkness and under a 'safe' green light (Grime *et al.*, 1981). Like many common grasses, perennial ryegrass seeds tend to germinate in the cool moist conditions in the autumn after shedding (Grime, 1981).

Persistence and Spread

Plant longevity is variable both between and within populations and ranges from annual/biennial to extremely persistent (Beddows, 1967). British cultivars grow well under cool moist conditions but are not the most winter hardy. Excessive autumn growth reduces tillering and the ability of a plant to survive a severe winter. If such plants are cut back hard they are unlikely to regenerate. Perennial rye-grass is very persistent in good rich soils but tends to decline after a few years on poor soil. It does not persist in pasture and re-sowing or sward renewal is required periodically (Grime *et al.*, 1988).

Seed is the primary form of perpetuation, however, Thompson *et al.* (1993) suggest that based on seed characters, perennial rye-grass seed ought to persist for less than 5 years in soil. Seeds of perennial rye-grass have minimal dormancy and are short-lived in soil (Chancellor, 1979). Seed sown in a 75 mm layer of soil in cylinders sunk in the soil and stirred periodically emerged mainly in the 12 months after sowing (Roberts, 1986). Just 0.1% emerged in the following 2 years. Seed buried in soil had negligible viability after 1 year. Seed buried in mineral soil at 13, 26 or 39 cm depth and left undisturbed retained 4 to 22% viability at 13 cm after 4 years depending on cultivar. There was only trace viability at other depths and no seeds were viable after 20 years (Lewis, 1973). Seed buried in a peat soil at 26 cm for 1, 4 and 20 years retained only 9% viability after 1 year but none survived after 4 years. Seed stored under granary conditions exhibited 79 to 86% viability after 1 year and trace viability after 4 years but was not viable after 20 years. Seed remained viable for over 7 years in dry storage but in soil all had germinated within a year (Rampton & Ching, 1970). Dry stored seed gave 97% germination after 1 year and 73% after 5 years (Kjaer, 1940). In other studies, dry-stored seeds retained good viability for 3-5 years but after 8 years only 1% would germinate (Beddows, 1967).

The seed is relatively heavy and natural dispersal is very limited. In laboratory studies only 3% of offered seeds were ingested by earthworms but of these 67% were recovered from the wormcasts (McRill & Sagar, 1973).

Management

Tall growing grasses suppress perennial rye-grass in undergrazed pasture (Kydd, 1964). Rye-grass benefits from grazing and becomes very aggressive under frequent grazing (Beddows, 1967). It has two peaks of leaf growth, a main flush in March-June and a lesser peak in August-September (Turkington & Harper, 1979). Perennial ryegrass plants may be weakened by severe grazing in spring and autumn during the main periods of growth (Blackman, 1933). In roadside verges, increased cutting frequency increased the incidence of perennial rye-grass (Parr & Way, 1988). In permanent grassland, perennial rye-grass is favoured by fertilizer applications (Williams, 1985). Vegetation pattern analysis in grassland has shown that white clover is positively associated with perennial rye-grass (Turkington & Harper, 1979).

The root feeding larvae of the cranefly (*Tipula paludosa*), a pest of grassland, graze the roots of perennial rye-grass. However, the growth of the grass is stimulated perhaps because the regenerated roots are finer and more efficient (Ramsell *et al.*, 1993). Root grazed perennial rye-grass plants were more competitive against broad-leaved dock when the two species were growing together.

In greenhouse tests, corn gluten meal (CGM) applied as a surface and incorporated treatment to soil has been shown to reduce plant development. Corn gluten hydrolysate (CGH), a water soluble material derived from CGM, was found to be more active than CGM when applied to the surface of pots of soil sown with perennial rye-grass seed (Liu & Christians, 1997).

Perennial ryegrass seed mixed with soil was killed by steaming at 75^{o}C (Melander *et al.*, 2002).

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