The biology and non-chemical control of Yorkshire Fog (*Holcus lanatus* L.)

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Yorkshire fog
(common velvetgrass, meadow soft grass, tufted soft grass)
***Holcus lanatus* L.**

Occurrence
Yorkshire fog is a tufted, fibrous rooted, perennial grass native on rough grassland, lawns, arable and waste ground and in open woods or at the margins of woodland (Stace, 1997; Beddows, 1961). It is generally distributed in the UK and often abundant (Clapham *et al*., 1987). Yorkshire fog occurs over a wide range of soil types (Thompson & Turkington, 1988). It is found in fen-meadow communities, poorly-drained and water-logged soils, low fertility and nutrient rich soils, pastures and meadows. Yorkshire fog is well adapted to growing in wet conditions but can survive a moderate drought, although growth is markedly reduced (Watt, 1978). It is tolerant of soil pH but grows best between pH 5.0 and 7.5. Yorkshire fog exhibits climatic tolerance over a wide altitude range. It is recorded up to 2,000 ft in Britain (Salisbury, 1961). Severe frost has been found to kill Yorkshire fog under certain conditions (Thompson & Turkington, 1988). Yorkshire fog is not resistant to treading and is obliterated by puddling and trampling (Bates, 1935; Gillham, 1955).

In a survey of weeds in conventional cereals in central southern England in 1982, Yorkshire fog was found in 2% of winter wheat and winter barley was not recorded in spring barley (Chancellor & Froud-Williams, 1984). In a 3-year set-aside, Yorkshire fog frequency exhibited some decline with increasing distance from the field edge but distribution was patchy (Rew *et al.*, 1992). In set aside land in Scotland it was one of the most frequent grasses and represented over 8% of the total ground cover (Fisher *et al.*, 1992). Yorkshire fog seed was found in 5% of arable soils in a seedbank survey in Scotland in 1972-1978 (Warwick, 1984). Yorkshire fog has been a common contaminant of grass crops grown for seed (Thompson & Turkington, 1988). It is a widespread weed of herbage seed crops and can reduce seed yield.

Yorkshire fog is deemed invasive because it forms a dense sward that eliminates both grasses and broad-leaved plants, reducing species richness (Weber, 2003). It is able to become a dominant component of the vegetation when grassland suffers disturbance (Burke & Grime, 1996). Yorkshire fog has been considered a weed in lowland ryegrass swards because of its low palatability to grazing animals once it begins to flower but there is some disagreement about this (Watt, 1978; Tansley, 1949). It tends to be less digestible than perennial ryegrass (*Lolium perenne*) (Wilman & Riley, 1993). In drier pasture the plant is hairy and animals avoid it (Morse & Palmer, 1925). In damp pastures, however, it is smoother and is eaten by cattle without objection. Yorkshire fog has been used for land stabilisation and for sheep grazing on soils of low nutrient status (Thompson & Turkington, 1988). Young shoots are readily eaten by stock, digestibility is good and mineral status relatively high but the dry matter content is low.

Yorkshire fog is sometimes stoloniferous but is often short-lived (Thompson & Turkington, 1988). It exhibits considerable variation in morphology and growth habit. For example, there is an agricultural cultivar, Massey Basyn, that produces tall plants with wide leaves. Ecotypic variants tolerant to salt, nutrient and pH status of soil and the presence of pollutants have been reported. Natural hybrids are formed with creeping soft-grass (*H. mollis*) (Beddows, 1961). The hybrids tend to resemble creeping soft grass in morphology and could easily be confused with this in the wild (Carroll & Jones, 1962).

Biology

Yorkshire fog flowers from June to September (Clapham *et al*., 1987). In Britain plants require vernalization in order to flower, with a minimum exposure of 25 days at a temperature of 5^{o}C needed (Thompson & Turkington, 1988). Flowers are wind pollinated and outcrossing predominates. The seeds start to become viable 5 to 9 days after flowering and are 100% viable after 20 days (Beddows, 1961). Seeds are shed from June to early autumn (Watt, 1978). Seed numbers per panicle range from 100 to 380. The average seed number per plant is 177,000 to 240,000 depending on when the parent plant emerges. Later emerging plants have progressively fewer seeds (Watt, 1976). Fewer tillers develop in time to become vernalized over winter and hence able to flower. Nevertheless, the panicles on late-emerging plants tend to produce more seeds to compensate for the smaller tiller number, so the seed production of late-summer – early autumn seedlings is still very large. In warmer regions Yorkshire fog has a tendency to flower in its first year but most British plants do not (Beddows, 1961).

Yorkshire fog seeds germinate over a wide range of soil temperatures immediately they become mature (Watt, 1978). The seeds germinate better in the light than in the dark, and at fluctuating rather than constant temperatures. In Petri-dish tests with seed maintained under high or low light intensity or in darkness, seed germinated virtually completely in the light but only 58% germinated in darkness (Grime & Jarvis, 1976). In widely fluctuating temperatures, light is less important for germination. Increasing the amplitude of temperature fluctuations increased germination in both light and dark up to an amplitude of 20^{o}C (Thompson & Whatley, 1983). However, there was a decrease in germination when the amplitude was 25^{o}C. Seeds are able to germinate immediately on bare soil in the open but germination is delayed in closed vegetation (Grime, 1981). Seed sown in a 75 mm layer of soil in cylinders sunk in the field and stirred periodically, emerged mainly from April to October (Roberts, 1986). Most seedlings emerged in years 1 and 2 but some emergence continued into year 3.

A simple seed population dynamics diagram for Yorkshire fog has been constructed based on data from a study where seed was scattered on plots that had been deep cultivated, surface cultivated or left as a closed sward cut to 75 mm (Mortimer, 1976). Invertebrate activity and greater openness at the soil surface increased the chance of seed burial. Around 37% of the seeds in the surface seedbank produced seedlings and up to 8% of these reached maturity. Excluding the invertebrates increased the number of seedlings that survived.

There is little winter growth of Yorkshire fog but it starts into growth at low temperatures in early spring (Grime *et al.*, 1988). It produces profuse tillers, and

regenerates vegetatively by developing new shoots and roots at the nodes (Thompson & Turkington, 1988). Yorkshire fog does not produce stolons in its first season (Salisbury, 1929). In established swards it forms large spreading clumps. Plants are relatively deep rooted, an advantage in soils of low nutrient status (Watt, 1978). However, Yorkshire fog also forms a dense network of surface roots (Beddows, 1961). There is evidence that Yorkshire fog may have an allelopathic effect on other plants in the sward. It is positively mycotrophic and growth is stimulated by the presence of a mycorrhizal infection (West, 1996).

Persistence and Spread

Thompson *et al.* (1993) suggest that based on seed characters, Yorkshire fog seed is likely to persist for longer than 5 years. Yorkshire fog can form a persistent seedbank (Grime *et al.,* 1988). Seed buried in mineral soil at 13, 26 or 39 cm depth and left undisturbed retained 17, 19 and 5% viability respectively after 4 years but none was viable after 20 years (Lewis, 1973). Seed buried in a peat soil at 26 cm for 1, 4 and 20 years retained only 1% viability after a year. Seed stored under granary conditions exhibited 82% viability after 1 year and 6% viability after 4 years but was not viable after 20 years. Seed in dry storage had 5% viability after 12 years (Beddows, 1961).

The grass is a prolific seed producer and the seeds are dispersed by wind. In set-aside fields in north-east Scotland, Yorkshire fog made up a significant proportion of the seed rain (Jones & Naylor, 1992). Seed was shed from early-August to early-October. Cutting time could influence the amount of seed returned to the soil. Although seeds show little dormancy, 14% remained viable after 10 years burial at 12.5 cm in soil. As seed production is very high, just a low level of dormancy can provide a substantial seedbank (Watt, 1976).

In perennial ryegrass seed tested in 1960-61, Yorkshire fog seed was found as a contaminant in 6.6% of seeds of English origin and 94.9% of seeds of Irish origin (Gooch, 1963). It was also present in other cultivated grass seeds. In clover and grass seed samples tested in Denmark for the period 1966-69, 1955-57 and 1939, Yorkshire fog seed was a contaminant in 1.7, 5.8 and 8.2% of samples respectively (Olesen & Jensen, 1969). In a survey of weed seed contamination in cereal seed in drills ready for sowing on farm in spring 1970, it was found in 1% of samples (Tonkin & Phillipson, 1973). All of this was home saved seed. It was a common contaminant of grass seed samples (Thompson & Turkington, 1988).

In tests, a proportion of seeds ingested by earthworms were recovered in worm casts (McRill, 1974). Up to 158 seedlings emerged per 100g of wormcast soil collected from grassland sites. Seed was found in 5% of worm casts collected on a neutral grassland (Thompson *et al.*, 1994). Yorkshire fog was not present in the vegetation cover and the seed probably came from previous horticultural activities on the soil. Moles bring Yorkshire fog seeds to the soil surface in their hillocks. Seeds eaten by sparrows were killed but those eaten by rooks remained viable. Yorkshire fog seed can be introduced in dung from livestock (Lake *et al.*, 2001).

Most reproduction is from seed but Yorkshire fog also spreads vegetatively (Thompson & Turkington, 1988). It regenerates by developing new shoots and roots at the stem nodes (Watt, 1978). Plants form a blanket of runners on the soil surface.

Semi-prostrate rosettes of shoots called mops may form at the end of the runners (Beddows, 1961). These mops root readily in contact with moist soil.

Management

Yorkshire fog produces abundant seed and can readily colonize bare soil and disturbed ground (Beddows, 1961). Avoid sowing the seeds as contaminants when putting land down to grass (Morse & Palmer, 1925). Isolated plants are conspicuous in leys and can build up into small colonies. In fields mown late for hay Yorkshire fog has time to ripen and shed seed before cutting (Beddows, 1961). Intensive mowing or grazing suppresses the establishment and spread of Yorkshire fog (Thompson & Turkington, 1988). Regular grazing keeps it in a vegetative and palatable condition. It is lax growing and close grazing reduces the number of potential shoot buds (Beddows, 1961). The more severe the defoliation, the fewer and smaller the remaining plants. Yorkshire fog benefits from undergrazing (Kydd, 1964). In abandoned pasture the sward can become dominated by mats of Yorkshire fog (Gibson, 1996). It can increase greatly in irrigated water meadows. It also increases with manuring (Tansley, 1949). Yorkshire fog is favoured by high nitrogen levels and while it tolerates acid soil it is reduced by lime applications (Williams, 1976; 85). Burning, ploughing and a lack of irrigation reduce the relative abundance of Yorkshire fog in pastures.

Yorkshire fog is grazed by rabbits but the hairy leaves and acrid sap deter them to some extent (Gillham, 1955). Yorkshire fog becomes more prominent when rabbit pressure is withdrawn (Tansley, 1949). When the rabbit population was decimated by myxomatosis in the 1950's, Yorkshire fog increased in grassland swards (Thomas, 1963). Yorkshire fog is attacked by a variety of insects that feed on the leaves and mine the stems, the grey field slug also consumes it. It can become infected with several fungal pathogens including ergot (*Claviceps purpurea*) (Beddows, 1961).

Acknowledgement

This review was compiled as part of the Organic Weed Management Project, OF 0315, funded by DEFRA.

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