The biology and non-chemical control of Rough Meadow-grass (*Poa trivialis* L.)

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Rough meadow-grass

(roughstalk bluegrass, rough-stalked meadow-grass)
***Poa trivialis* L.**

Occurrence

Rough meadow grass occurs as both an annual and a perennial grass with procumbent tillers some of which become leafy stolons (Stace, 1997). It is native in open woods, marshes, ditches, damp grassland, cultivated and rough ground throughout the UK (Clapham *et al*., 1987). It is widely distributed in lowland areas of Britain, particularly on rich, moist, heavy soils. Rough meadow grass has creeping stolons and is common on moist or even on wet soils (Tansley, 1949). It is often characteristic of the latrine areas of horse grazed grassland (Gibson, 1996). The species is found in the hedge bottom and field margins as well as spreading into arable fields (Marshall, 1985; 1989). In early surveys of Bedfordshire, Hertfordshire and Norfolk it was found mainly on clay, loam and chalk but only occasionally on sandy soil (Brenchley 1911; 1913).

Rough meadow-grass is an indigenous grassland species that has become increasingly important as a weed of winter cereals (Froud-Williams *et al*., 1986; Unwin *et al.*, 1990*)*. It occurs in all types of grassland especially newly established leys (Froud-Williams & Ferris, 1987). It can become a problem in the 2nd and 3rd years of a ley (Blair, 1970). It is also a problem in grass seed crops (Budd, 1974). In 1975 it was said that 20% of arable crops were infested with rough meadow-grass (Froud-Williams & Ferris, 1987). In a survey of weeds in conventional cereals in central southern England in 1982, rough meadow-grass was found in 29, 14 and 7% of winter wheat, winter barley and spring barley respectively (Chancellor & Froud-Williams, 1984). In a similar survey of winter oilseed rape in 1985, it was found in only 3% of crops (Froud-Williams & Chancellor, 1987). In a study of seedbanks in some arable soils in the English midlands sampled in 1972-1973, rough meadow-grass was recorded in 19% of the fields sampled in Oxfordshire and 38% of those in Warwickshire but never in large numbers (Roberts & Chancellor, 1986). Seed was found in 1.5% of arable soils in a seedbank survey in Scotland in 1972-1978 (Warwick, 1984). It was also the second most abundant grass weed in a seedbank survey in swede-turnip fields in Scotland in 1982 (Lawson *et al.*, 1988). It was found in 85% of fields sampled. Under natural regeneration in set-aside in southern England, barren brome frequency increased in the vegetation cover between years 1 and 3 (Wilson, 1992). In a survey of weed seeds in pasture soils in the Netherlands in 1966, rough meadow-grass was the second most frequent species recorded (Van Altena & Minderhoud, 1972).

Rough meadow-grass was considered an important constituent of permanent grassland in mixtures with other grasses. It is a palatable grass but is now little sown. It is not very productive on dry soils and is liable to die-out after 4-5 years according

to some farmers (Elliot, 1943). Rough meadow-grass is often a colonist following sward deterioration of cultivated grassland (Grime *et al.*, 1988).

Biology

Rough meadow-grass flowers in June and is wind pollinated (Grime *et al.*, 1988). Plants require a period of exposure to winter cold in order to flower (Budd, 1970). Seeds are shed between June and August. There may be 200-1,700 seeds per flower head (Budd *et al.*, 1982). Rough meadow-grass can produce 29,000 seeds per plant but this is reduced to 14,000 in a winter cereal (Clarke *et al.*, 1995). In a cereal crop, rough meadow-grass produced more than 1,000 seeds per plant (Froud-Williams & Ferris, 1987). Innate dormancy is short but dormancy can be enforced by soil burial. Proximal seeds are less dormant and germinate more readily than distal seeds. Proximal seeds tend to clump together at and after dispersal due to threads at the base of the seeds.

The seed requires light for germination which ensures only seed at or near the soil surface will germinate and establish. In germination studies, freshly-collected seed required exposure to red light to promote germination (Froud-Williams *et al.*, 1984b). The requirement was lost following a period of burial or dry-storage. Seeds are able to germinate immediately on bare soil in the open but germination is delayed in closed vegetation (Grime, 1981). However, seeds gave over 70% germination at alternating temperatures in darkness or under a safe green (Grime *et al.*, 1981). There was just 18% germination at a constant temperature in darkness. Seed from grassland populations was much less dormant than seed from arable situations (Froud-Williams *et al.*, 1986; Froud-Williams & Ferris, 1987). Seed from both grassland and arable sources had high viability. Germination is enhanced by wetting and drying of the seeds.

Dry-storage of seed leeds to a gradual loss of dormancy. Dry-stored seed germinated over a wide range of constant temperatures from 7 to 23^{o}C with maximum germination at 12^{o}C (Froud-Williams *et al.*, 1986; Froud-Williams & Ferris, 1987). At constant temperatures, germination was curtailed below 5^{o}C and above 20^{o}C (Froud-Williams, 1985). Buried seed lost dormancy in both spring and autumn but germination on the soil surface was largely confined to the autumn after shedding. Germination is reduced when seeds are at a high density in soil. Laboratory germination studies of dry-stored seed in combinations of light or dark, constant 25^{o}C or alternating 20-35^{o}C, with or without KNO^3 showed maximum germination in all combinations except constant temperature in the dark without nitrate (Nelson, 1927).

Seedlings emerge in autumn and spring (Grime *et al.*, 1988). Seed sown in a 75 mm layer of soil in cylinders sunk in the field and stirred periodically emerged from March to October (Roberts, 1986). Seed sown outside in pots and boxes at different depths cultivated or not, emerged mainly in winter when left on the soil surface or sown at 25 mm without cultivation (Froud-Williams *et al.*, 1984a). There was little germination of seed sown at 75 mm and cultivated in February or June. The optimum depth of germination was 0-10 mm and the maximum was 30 mm. In grassland, peak emergence is in September (Froud-Williams & Ferris, 1987).

In order to flower in the year following emergence, rough meadow-grass seedlings need to be vernalised by exposure to cool winter conditions (Budd, 1974). Seedlings

that emerge in autumn-sown crops become vernalised and are capable of producing seed. Those that emerge in spring-sown crops are not. Rough meadow-grass has creeping stems and the foliage overwinters in a reduced form (Boyall *et al*., 1981). It is cold tolerant and remains winter green but makes little growth until April (Grime *et al.*, 1988).

Persistence and Spread

Reproduction by seed is important and rough meadow-grass has relatively long-lived seeds for a grass (Chancellor, 1979). Thompson *et al.* (1993) suggest that based on seed characters, rough meadow-grass seed should persist longer than 5 years in soil. Seeds have been recorded in large numbers in the soil beneath pastures even though the plant may be poorly represented in the vegetation (Champness & Morris, 1948). In Belgium, it was one of the main species that remained in the seedbank of a reclaimed heath that had been under arable cropping since 1924 and then under grassland from the 1960's (Stieperaere & Timmerman, 1983).

Rough meadow-grass seed has occurred as a contaminant in cereal seeds. In the period 1978-1981, rough meadow-grass seed was found in 13-16% of wheat and 7-10% of barley seed samples tested (Tonkin, 1982). It was found in over 1.5% of pre-certification barley seed samples tested in 1996/97 but was not found in certificated samples (Don, 1997). In herbage seeds, the web of hairs at the base of the rough meadow-grass seed cause the seeds to cling to together and to the herbage seeds making separation difficult (Budd *et al.*, 1982).

The seeds are ingested by earthworms and viable seeds have been recovered in wormcasts (McRill & Sagar; 1973, McRill, 1974). Following passage through an earthworm, seed germination increased from 66 to 90%.

Management

Autumn ploughing should ensure no vegetative material remains on the soil surface to regenerate. Shallow or reduced cultivation is less effective in burying the grass and preventing survival. Studies of the effect of physical damage on the control of rough meadow-grass showed that cutting at the soil surface was more effective than partial burial (Jones *et al*., 1995). Complete burial, alone and after uprooting seedlings, was the most consistently effective treatment. There was the potential for recovery if seedlings were left on the soil surface or if just the roots were buried. Shoot fragments can regenerate following cultivation in arable land (Grime *et al.*, 1988). Shading after uprooting, as would occur under a crop canopy, improved the level of control (Jones *et al.*,1999). Seedlings have fibrous roots and are easily dislodged by harrowing and other cultivations (Jensen & Andreasen, 1993). After crop harvest, ploughing buries the freshly shed seeds but this may lead to a future weed problem. Winter cropping favours *Poa* species as does increasing the water holding capacity of soil by straw incorporation.

Rough meadow-grass seedlings that emerge in spring barley are not vernalised so remain vegetative and are incapable of producing seed (Budd, 1970; 1974). Spring barley can therefore be used as a cleaning crop provided that any overwintered plants are destroyed during seedbed preparations. Plants from autumn emerging seedlings in winter cereals or those that survived after spring seedbed preparations will produce seed. It is important to prevent this being incorporated into the soil by delaying post-

harvest cultivations to allow the freshly shed seed sufficient time to germinate. Shed seed is more likely to germinate under moist conditions. Seeds that are buried are likely to become dormant and will persist until cultivations stimulate germination in future crops.

In grass seed crops, delaying stubble cultivations for 3 months after harvest allows shed seeds time to germinate on the soil surface and avoids burying viable seeds where they may persist (Budd, 1970). Growing a spring barley crop after the grass seed crop will reduce infestations further.

In permanent grassland, rough meadow-grass was favoured by fertilizer application (Williams, 1985). Both percentage cover and seed numbers in the soil increased. The thin creeping stolons are shallow rooted and the plant depends on surface moisture for survival (Blair, 1970). Growth is restricted in dry periods. Rough meadow-grass does not persist under close mowing and is susceptible to trampling (Grime *et al.*, 1988). Under severe grazing, rough meadow-grass will soon become established and within 5 years it can make up 50% of the sward (Spedding, 1966). The main period of growth is from May to August (Blackman, 1933). Rough meadow–grass is favoured by hard grazing from May to June. However, undergrazing at other times can be responsible for an increase in rough meadow-grass.

In a five-year study of weed spread from arable field margins, a boundary strip 2 m wide was sown with perennial ryegrass, mown twice a year, or was kept bare and rotovated twice a year (Milson *et al.*, 1994). In comparison with a winter wheat cropped strip the boundary strips delayed the spread of rough meadow-grass from the hedge into the field but did not prevent it. There was little difference between the boundary strip treatments.

The seeds of rough meadow-grass are consumed by several species of ground beetle (Tooley *et al.*, 1999).

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