Prediction of Reproductive Initiation from Relative Ear Emergence Timing in *Lolium perenne* L. Varieties

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Introduction During May to June perennial ryegrass varieties predominately comprise of reproductively developing tillers in which the digestibility of the stem falls much faster than the leaf, with associated water-soluble carbohydrate and protein losses (Terry and Tilley, 1964). Even when at similar digestibilities, leaf has a 20% higher voluntary DM intake than stem, (Laredo and Minson 1975) and so stemmy compositions limit animal intake. Spring defoliation timing is known to interact with the degree of reproductive development to affect stem content in a sward (Holmes & Hoogendoorn, 1983). Using defoliation timing to control stem content has not, however, been wholly effective in practice, partly because the degree of reproductive development can t be easily assessed prior to visible stem elongation. This study examined the relationship between the timing of reproductive initiation and ear emergence in eight perennial ryegrass varieties and determined the effect of latitude and meteorological conditions on the timing of these growth stages.

Materials & methods The timing of reproductive initiation and ear emergence were measured on 40 vernalised spaced plants for each of eight perennial ryegrass varieties in Ireland at 54°32′N in 2005 and on the same plants on a similar loam soil at 52°09′N in 2006. The mean ear initiation (EI) date of each variety was determined by examining the apex of one tiller from each plant on alternative days from mid-March, for the presence of the diagnostic double ridge of reproductive initiation. The critical day length (minimum length of daylight for reproductive initiation) was calculated in hours for each plant by interpolation of the standard day length x latitude relationship. Ear emergence (EE) was recorded as the date and day length when three seed heads had visibly emerged on a plant. The 10-year (1997-2006) mean date of ear emergence (MDEE), that is used to classify varieties in the UK and EU Common Catalogue was compiled at the northern site for the eight test varieties. Temperature (℃) and photosynthetically active radiation (PAR), (400-700nm, MJ m^{-2} day^{-1}) were accumulated from 1 January to EI and between EI and EE in both 2005 and 2006 at both sites.

Results & discussion There was a significant effect of site and variety on both EI and EE. When the day length difference between the two latitudes (maximum of 60 minutes on 16 June) was removed, EI responded to a fixed photoperiod in each variety at both sites/years, with only a minor climatic response associated with the growth time for a visible apical change to occur. Timing of ear emergence was dependent on growing conditions not photoperiod and so differed significantly ($p<0.001$) between sites/years, though variety rank order was largely retained. The timing of ear emergence was also strongly correlated with the EI date at each site (northern $r^2 = 0.95$, southern $r^2 = 0.92$ sites) and also when combined with the official MDEE for the eight varieties ($r^2 = 0.94$). As a consequence EI correlated very strongly with MDEE ($r^2 = 0.94$) $y = 0.0997x - 3897.8$.

Conclusions The discovered relationship between EI and MDEE was sufficiently robust to provide a calibration to estimate the critical initiation date of any variety on the EU common catalogue for which MDEE dates are available on the UK, though some caution may be necessary if applying to variety maturities and latitudes beyond those studied.

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