Evaluation of dry matter yield of ryegrass varieties on Irish grassland farms

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Abstract

Increasing grass growth and utilisation on Irish dairy farms is shown to have a positive effect on farm profitability. This study was designed to establish the productivity of individual grass varieties under commercial conditions on-farms and compare this to their relative performance in recommended-list plot studies. The objective was to determine to what extent the plot tests are representative of on-farm performances. PastureBase Ireland (PBI) was established in Ireland as the national grassland database. 44 commercial dairy farms across different regions and soil types were selected to estimate grass yield using the PBI decision support tool. On these farms a number of grass varieties were sown as monocultures, each farm sowed the variety Tyrella (diploid 'D') (as a control), and a range of other varieties were also sown: AberGain (tetraploid 'T'), Kintyre (T), AberChoice (D), Twymax (T), Drumbo (D), and Astonenergy (T). The range between the highest and lowest yielding varieties in the first full growing season was 1.6 Mg dry matter (DM) ha^{-1}, but the level of variability of the on-farm recordings meant that no significant differences were recorded. When the relationship between varieties under simulated grazing plots and on-farm evaluations was examined it was found that every additional Mg of DM ha^{-1} in plot evaluations actually represented 0.64 Mg DM ha^{-1} on-farm.

Keywords: PastureBase Ireland, ryegrass, variety, evaluation, on-farm

Introduction

Grazed grass is the lowest cost feed available to ruminant production systems in Ireland (Finneran *et al.*, 2010). Irish producers enjoy a competitive advantage over counterparts who operate higher intensity confinement-based systems as a result of operating predominantly pasture-based production systems which are capable of sustaining high levels of physical and financial performance. There has been a surge in the level of interest in pasture-based systems in many temperate and subtropical regions of the world. This is a direct result of years of increased price volatility for both inputs and outputs (Dillon *et al.*, 2005). Central to the success of pastoral systems is the selection of the appropriate grass variety suited to localised environments.

The development of a comprehensive national grassland database such as PastureBaseIreland (PBI; http://www.pasturebase.teagasc.ie) has the potential to considerably increase grassland-related understanding. Generating phenotypic dry matter (DM) yield data for individual varieties on commercial farms is of particular interest in providing valuable information on individual variety performance across a range of different environments (e.g. soil type) and management systems. Routine on-farm evaluation of large numbers of grass varieties is prohibitively expensive and the internationally followed practice is to use small scale replicated field-plot trials under fixed protocols. The development of an on-farm DM yield phenotyping strategy would facilitate the quantification of variety DM yield across a much wider range of environmental conditions and management practices than can be achieved with traditional plot evaluation trials. Long-term experiments such as that described by Wilkins and Humphreys (2003) are necessary to evaluate varieties for persistence and stress tolerance. The objective of the present study was

to quantify the differences in grass DM yield of a number of recommended list grass varieties on a large number of Irish dairy farms and relate this performance to the yield of these varieties from plot studies within the recommended list evaluation scheme.

Materials and methods

The on-farm variety evaluation study began with the establishment of monocultures of several varieties on 44 different dairy farms. Each variety was sown at 34.5 kg ha^{-1} per paddock. The varieties used were: AberChoice (D), AberGain (T), Astonenergy (T), Drumbo (D), Kintyre (T), Twymax (T) and Tyrella (D). Where (D – diploid) and (T – tetraploid).

Tyrella was established on each of the 44 farms as a standard control variety. Varieties had been reseeded into the swards in either 2011 or 2012. DM yield was determined on 228 paddocks from 1 January 2013 until 10 December 2013. Grazing and silage yields (assessed prior to grazing or at the conservation harvest date) were measured separately and where necessary combined to generate total DM yield. The herbage mass of each paddock was estimated on a regular basis by visual assessment (calibrated by cutting and weighing) (O'Donovan *et al.*, 2002) or by measurement with rising plate meter (Castle, 1976). Growth rate of varieties was only calculated when the time between grass measurements did not exceed 16 days; all the farms in the study achieved this standard throughout the year. Farms were provided with guidelines to estimate DM percentage based on prevailing weather conditions.

Least squares means for the different varieties were estimated using mixed models; paddock nested within farm was included as a random effect with a compound symmetry covariance structure assumed among paddocks within farm. Only monocultures of known varieties were retained. The dependent variable was total paddock yield (kg DM ha^{-1}). Fixed effects considered in the mixed model were sowing rate, number of years since reseeding, and variety. An additional analysis replaced the variety (class effect) with the continuous fixed effect of DM yield from the 2013 recommended list plots for the same varieties used on farms; the regression coefficient from this analysis is the expected change in paddock DM yield (on the commercial farms) per unit change in DM yield from the recommended list plot studies.

Results and discussion

The range in DM yield between the highest and lowest yielding variety on-farm was 1.6 Mg DM ha^{-1}. For the on-farm trials (Figure 1), the Least squares means DM yield (Mg DM ha^{-1}) per variety were AberChoice (12.7; standard error (se) =0.878), AberGain (T) (13.6; se=0.858), Astonenergy (T) (11.97; se=0.540), Drumbo (12.4; se= 0.894), Kintyre (T) (13.5; se=0.590), Twymax (T) (12.6;
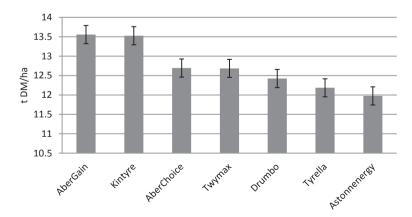

Figure 1. On-farm variety evaluation dry matter yield (Mg dry matter (DM) ha^{-1}) nationally in 2013

se=0.742) and Tyrella (12.2; se=0.412). The overall conversion factor between the farm generated yields and the RL plots simulated grazing yields was an increase of +0.67 Mg (se=0.71) on-farm per Mg yielded from the plots which is non-significant (P=0.35). Despite these overall mean differences in yield no significant yield differences were recorded between varieties on-farm. Due to the high level of between-farm variability and what is currently the first year of a longer term study, it was concluded that the relatively low sample size currently available is likely to have generated type II errors. Over time with increased farm measurements and an increase in cumulative years data it is expected that this will be overcome and with increased precision, it will be possible to better determine if these varieties perform significantly differently between farms and compared to plot based evaluations.

Conclusions

On-farm grass variety evaluation is potentially an alternative means determining the true agronomic potential of ryegrass varieties. The current network of on-farm grass growth monitoring through the PBI national grassland database is becoming an important means of knowledge transfer on grassland performance potential to ruminant farmers in Ireland. This study has quantified the initial levels of variability encountered by farmer-generated yield data and the need for very large data sets to screen out the inherent variability. The continuation of this study will determine at what level of data collection that varietal differences in performance can be isolated from the background noise. By making assessments across a wide range in such factors as topography, fertilizer use, stock management and farm specific micro-climates, it will be possible to determine how robust and relevant the variety performance ranking from limited plot evaluation trials are to the spectrum of farms that rely on this information to optimise grass performance.

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