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Variability in quantity and composition of water soluble carbohydrates among Irish accessions and European varieties of perennial ryegrass

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Introduction The objective of this study was to identify perennial ryegrass accessions displaying high fructose and glucose contents and an improved ratio between fructose and glucose fractions across different time points throughout the year. Fructose and glucose are the main constituents of the water soluble carbohydrate (WSC) fraction in perennial ryegrass. For animal nutrition the amount of WSC is crucial as it is the primary energy source available to metabolise the intake of plant protein. The ratio between fructose and glucose fractions is important since fructosan chains, which are an excellent energy source for ruminants, are built from fructose. Furthermore the seasonal variability of WSC content in feed reflects the changing balance between protein and carbohydrates.

Materials and methods In the summer of 2003, 33 perennial ryegrass entries were grown from true seed and planted as spaced plants in the field. Forty plants per accession were divided into 4 pools for analysis. The plant material was selected from a collection of historic indigenous Irish accessions held at Oak Park (23 entries) and current commercially grown varieties (10 entries). In 2004, at three time points during the growing season, samples were taken and processed for WSC analysis via HPLC as described by Jafari *et al*. (2003). Means and standard deviations were calculated and entries were assigned to one of four classes (1 = very good to 4 = poor) based on percentage of dryweight attributed to carbohydrates.

Results At the three time points across ecotypes and varieties a high variability was found for both the WSC content and the ratio of fructose/glucose (Table 1), *e.g.* contents of fructose ranging between 1.65 and 18.99%. Generally the material displayed wide genetic variation across the traits investigated. Among the ecotypes, several entries were superior to the commercial varieties at the third cutting time point (Table 2).

Table 1 Means ($\bar{x}$), standard deviations (SD), minimum and maximum percentage of fructose, glucose and total water soluble carbohydrate (WSC), and ratio of fructose/glucose (ratio) across three cuts

	% fructose				% glucose				% WSC				ratio			
	$\bar{x}$	SD	*min*	*max*	$\bar{x}$	SD	*min*	*max*	$\bar{x}$	SD	*min*	*max*	$\bar{x}$	SD	*min*	*max*
cut 1	8.89	2.90	2.36	15.77	3.99	1.08	1.57	6.89	12.90	3.85	4.11	21.49	2.22	0.40	1.35	3.51
cut 2	6.34	1.96	2.47	11.29	4.39	1.24	2.04	6.68	10.73	3.13	4.54	17.37	1.44	0.19	1.04	2.29
cut 3	8.93	3.74	1.65	18.99	4.40	1.81	1.07	12.34	13.33	5.19	4.18	27.19	2.11	0.64	0.65	5.10

Table 2 Number of varieties and ecotypes within the four classes of carbohydrate content

	fructose				glucose				WSC				ratio			
index	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*
	varieties															
cut 1	2	4	4	-	1	5	4	-	2	5	3	-	-	6	2	2
cut 2	1	6	3	-	1	6	3	-	1	6	3	-	-	7	3	-
cut 3	1	7	2	-	1	6	3	-	1	8	1	-	-	7	3	-
	ecotypes															
cut 1	1	17	5	-	2	16	5	-	1	17	5	-	4	13	4	2
cut 2	1	17	5	-	1	16	6	-	2	16	5	-	-	20	3	-
cut 3	2	15	6	-	2	2	4	-	5	15	6	-	3	15	4	1

Conclusions Perennial ryegrass genetic resource collections such as that held at Teagasc Oak Park, hold a great potential for improving the quality of ryegrass varieties. Further ryegrass traits should also be examined, *e.g.* digestibility and fatty acids. The high quality ecotypes identified in this study will be investigated further in 2005-2006.

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Reference

Jafari, A., V. Connolly, A. Frohlich, & E. J. Walsh (2003). A note on estimation of quality parameters in perennial ryegrass by near infrared reflectance spectroscopy. *Irish Journal of Agricultural & Food Research*, 42, 293-300.