VARIABILITY FOR CHEMICAL COMPOSITION IN TALL FESCUE PROGENIES, YIELD AND TRAITS ASSOCIATED WITH *IN VITRO* DIGESTIBILITY

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ABSTRACT

Efficient selection of tall fescue (*Festuca arundinacea*, Schreb.) would be aided if quality traits associated with yield could be identified. The purpose of this study was to assess the variation of protein, fiber components and digestibility in tall fescue progenies and to examine the relationships among agronomic and quality traits. Seventeen progenies from a polycross and self mating system, previously selected for dry matter yield and yield components, were evaluated for crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL) and *in vitro* organic matter digestibility (IVOMD). Significant (P= 0.05) variation among genotypes was observed for all quality traits. Among the high-yielding progenies, cluster analysis evindentiated a homogeneous group for better quality traits (higher CP content; greater IVOMD; reduced NDF, ADF or lignin content).

KEYWORDS

Tall fescue progenies, protein, fiber, *in vitro* digestibility, dry matter yield

INTRODUCTION

Tall fescue (*Festuca arundinacea*, Schreb.) is renowned for its ability to withstand both drought and high temperatures, but its forage quality has been criticised. However, in recent years, many herbage-quality attributes of tall fescue have been identified and researched (Sleper, 1985). Herbage quality is considered a major factor in influencing animal performance and it is commonly evaluated through chemical parameters such as crude protein and fiber components, closely related to the forage digestibility.In tall fescue, significant variation for protein concentration and cell wall constituents and their relationship with invitro digestibility has been reported, by several workers (Soh et al., 1984; Bughrara et al., 1991). Changes in tall fescue quality are associated with leaf-stem ratio, stage of maturity and date of harvest. Stems and reproductive parts of forage grasses are usually of lower forage quality than the more leafy vegetative growth. The present study was undertaken, to assess the qualitative characteristics of genotypes, previously selected for agronomic desirability, with the objective to examine relationships among agronomic and quality traits.

METHODS

Nine polycrossed and eight selfed progenies, selected during the years 1989-92 for forage yield and yield components, were evaluated. They derived from Mediterranean (Sd 1, Sardegna 1; Sd 2, Sardegna 2; MJ, Maris Jebel;) and continental (Ld 1, Lodi 1; Ld 2, Lodi 2; Ld 3, Lodi 3; Ld 4, Lodi 4; S170, H. S 170) populations. Selection, development and planting of materials used in this study have been previously described by Martiniello et al. (1995). For quality analyses, crude protein content, fiber components and *in vitro* digestibility, were determined. A random sample of forage (30 tillers) was taken from each plot, dried and subdivided into leaf and stem fractions. The resulting samples were then redried at 65°C, ground in a Cyclotec mill to pass a 1-mm screen. Laboratory analyses were performed only on leaves from the first harvest of the years 1991 and 1992, sampled at heading stage of growth. The genotypes were two times replicated in a random complete block design. The neutral detergent fiber, ADF and ADL were determined by methods of Goering and Van Soest (1970). Crude protein percentage (N x 6.25) was estimated by micro-kjeldahl analysis with a Kjeltec Auto 1030 Instrument. Digestibility of organic matter was determined using enzymatic method (Bughrara and Sleper 1986) in which rumen liquor is replaced by a prepared cellulase solution. Procedure involved an acid-pepsin pre-treatment of the forage samples, prior to digestion in the prepared cellulase solution. Digestibility estimates were standardised against three high and three low standards of know in vivo digestibility. Data were analysed using factorial analysis with years and genotypes as main factors. Where F-tests were significant, LSD (P= 0.05) were assessed, to determine differences among progenies and years. To identify the progenies better adapted to the weather conditions, according to production and quality parameters, data were subjected to the cluster analyses described by Scott and Knott (1974).

RESULTS AND DISCUSSION

Because year x progeny interaction effects were significant for CP, NDF, ADF, ADL and IVOMD, values for both years were presented (Table 1). Differences among polycross progenies were highly significant (P< 0.01) for all traits (data not shown) and between years (Table 1). Particularly, in the second year, progenies averaged 16.5% higher in CP, 6.7% in NDF, 6.3% in ADF, 8.5% in ADL and 2.5% in IVOMD, than the first year. Ranges of variation were (11-14.5%) for CP, (50-57%) for NDF, (29-33%) for ADF, (1.4-2.1%) for ADL and (57-63%) for IVOMD. As regard selfed progenies, there were differences highly significant (P< 0.01) among progenies, for all traits (data not shown), while differences among years were significant only for NDF, ADF and IVOMD. In the second year, progenies had a higher percentage for NDF and ADF traits (6.5% and 9.8%, respectively) and a lower percentage for IVOMD (2.1%), than the first year. Results of cluster analysis (Table 2) showed that crude protein and fiber components were related to DMY and IVOMD. In the progenies polycross (previously selected for higher production and higher tiller density), a group having higher values of CP (Sd 1.2, MJ 1.1, MJ 1.2 and MJ 1.4) were identified. Some progenies of this group (MJ 1.1, MJ 1.2 and MJ 1.4) had higher values in IVOMD and lower values in NDF, while, progeny Sd 1.2 had higher values for all fiber components and an lower IVOMD. Selfed progenies (previously selected for higher DMY and both, tiller density and leaf-stem ratio) with higher values of CP (Sd 2.2; MJ 1.1; MJ 1.2; S170 1.5; S170 1.6 and S170 1.7) had also higher fiber percentage and lower IVOMD values, except MJ 1.1; MJ 1.2 and S170 1.5). Progenies MJ 1.1 and MJ 1.2, evaluated in both polycross and self mating system, in both higher cluster groups were presented, as having similar and higher of CP and IVOMD traits, therefore it seems that these last progenies were not affected by mating systems. The study underlined that selection for quality traits concerning high leaf protein and low fiber content, associated with digestibility and increased yield is a difficult target to achieve. Nevertheless, by cluster analysis we had singled out ten high- yielding progenies with higher leaf CP (four polycrossed and six selfed) and five, high-yielding, with higher CP and IVOMD (MJ 1.1, MJ 1.2 and MJ 1.4, for polycrossed; MJ 1.1 and S170 1.5, for selfed). The results provide useful indications on the progenies quality characteristics. Superior progenies, for both DMY and quality traits, could be used to identify the high-performing parents for developing synthetic variety.

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Table 1

Means (%) for crude protein (CP), cell wall components (NDF, ADF and ADL) and in vitro organic matter digestibility (IVOMD), in leaves of polycross and self progenies, at the first harvest.

Progeny	CP		NDF		ADF		ADL		IVOMD	
	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992
Polycross					%					
Sd 1.1	11.1	13.1	52.5	56.7	29.8	32.0	1.79	1.88	57.7	59.3
Sd 1.2	11.1	13.8	53.1	55.2	30.6	32.1	1.97	2.03	56.7	60.3
Sd 1.4	11.0	12.2	49.7	57.2	29.1	31.9	1.59	2.03	60.0	58.6
Sd 1.5	10.5	13.8	53.5	55.7	31.0	31.3	1.63	1.99	58.3	60.8
Sd 1.6	10.6	12.6	51.2	54.2	28.9	31.4	1.40	1.63	56.8	60.4
Sd 1.7	10.6	12.6	50.7	52.4	30.0	30.5	1.96	1.56	61.6	63.0
MJ 1.1	13.1	13.0	51.3	55.3	29.9	32.5	1.77	1.82	59.5	61.4
MJ 1.2	11.0	14.2	50.8	55.3	30.1	33.3	1.71	1.96	60.6	61.4
MJ 1.4	11.4	14.5	51.2	56.0	30.8	33.0	1.80	2.10	61.0	59.9
MEAN	11.1	13.3	51.6	55.3	30.0	32.0	1.73	1.89	59.1	60.6
LSD (0.05) (years)	0.08		0.18		0.06		0.75		0.12	
LSD (0.05) (y x g)	0.17		0.39		0.25		0.13		0.35	
Self					%					
Sd 2.2	12.3	11.2	53.3	58.5	30.8	35.4	1.78	2.86	58.4	54.9
Ld 1.8	10.7	9.9	53.1	59.1	32.6	36.6	2.76	2.50	57.4	53.2
Ld 3.4	11.1	10.0	54.6	60.0	34.1	36.9	2.58	2.22	56.4	55.6
MJ 1.1	12.6	11.8	52.8	56.2	32.6	34.9	2.08	2.37	58.8	58.9
MJ 1.2	11.1	12.7	52.9	54.9	31.1	37.2	2.07	2.62	57.4	60.4
S170 1.5	11.2	11.3	53.1	52.7	31.3	32.3	2.96	3.01	58.4	59.2
S170 1.6	10.0	12.8	53.8	58.9	32.4	36.8	3.59	2.52	57.6	54.8
S170 1.7	13.5	11.7	56.0	58.8	32.2	34.9	2.61	3.07	55.7	53.5
MEAN	11.6	11.4	53.7	57.4	32.1	35.6	2.55	2.65	57.5	56.3
LSD (0.05) (years)	NS		0.2		0.2		NS		0.7	
LSD(0.05) (y x g)	0.5		0.3		0.5		0.2		1.4	

Ld= Lodi; S170= H. S170 synthetic variety; Sd= Sardegna;
MJ= Maris Jebel; y= years; g= genotypes.

Table 2

Selected homogeneus cluster group of polycross and self progenies, for dry matter yield (DMY), tiller density (TIL), leaf-stem ratio (LSR) (means over four harvests and four years) and for crude protein (CP), cell wall components (NDF, ADF, ADL) and in vitro organic matter digestibility (IVOMD) in leaves (means at the first harvest of years 1991 and 1992).

Progeny	DMY	TIL	LSR	CP	NDF	ADF	ADL	IVOMD
Polycross	(g m-2)	(nº m-2)	(g kg-1)			%		
Sd 1.1	562	2155	——	——	54.6	30.9	——	——
Sd 1.2	516	1848	——	12.5	54.1	31.4	2.00	——
Sd 1.4	463	1894	——	——	——	——	——	——
Sd 1.5	435	1686	——	——	54.6	31.1	——	——
Sd 1.6	546	2138	——	——	——	——	——	——
Sd 1.7	458	1626	——	——	——	——	——	62.3
MJ 1.1	522	1529	——	13.1	——	31.2	——	60.4
MJ 1.2	441	1650	——	12.6	——	31.7	——	61.0
MJ 1.4	422	1790	——	12.9	——	31.9	1.95	60.4
Mean of progenies								
Selected	485	1813	36.3	12.8	54.4	31.4	1.97	61.0
Discarded	371	1171	46.8	11.8	52.9	30.3	1.76	58.9
Self								
Sd 2.2	487	1425	——	11.7	55.9	——	——	——
Ld 1.8	470	1541	56.0	——	56.1	34.6	——	——
Ld 3.4	470	——	52.5	——	57.3	35.5	——	——
MJ 1.1	543	1477	——	12.2	——	——	——	58.8
MJ 1.2	419	1934	——	11.9	——	34.2	——	58.9
S170 1.5	489	——	59.9	11.3	——	——	2.98	58.8
S170 1.6	476	——	60.7	11.4	56.3	34.6	3.06	——
S170 1.7	491	1399	——	12.6	57.4	——	2.84	——
Mean of progenies								
Selected	481	1555	57.3	11.8	56.6	34.7	2.96	58.8
Discarded	399	1171	46.8	10.4	53.8	33.0	2.38	55.7