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Edited by

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Agromorphological diversity in North Spanish *Agrostis capillaris*

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Abstract

Fourteen *Agrostis capillaris* L. accessions collected from northern Spain were characterised in a low-fertilisation regime at Carreño (43° 35' N, 5° 47' W, 80 m.a.s.l.) in Asturias during two years (2004 and 2005) in a randomised complete block design with two replicates of 15 plants per accession. One commercial cultivar (*Agrostis capillaris* cv 'Golfin') was also included in this study. The entries included accessions and cultivar were evaluated for agronomical and turfgrass quality characteristics each year. The collected data was reduced to four principle components that cumulatively explained 82.6% of the total variance. Cluster analysis was useful in identifying four groups of accessions describing 57% of the phenotypic variation among accessions. Cluster 1 consisted of seven accessions with an intermediate growth habit, late heading and with the narrowest flag leaf and shortest upper internodes. Cluster 2 contained three accessions with the latest heading, the most erect growth habit, darkest green colour as accessions of cluster 3. Cluster 3 contained the two earliest heading accessions and the widest flag leaf and longest upper internodes. Cluster 4 consisted of two accessions and the cultivar 'Golfin' lightest green colour and intermediate characters among the other clusters.

Keywords: bentgrass, characterisation, multivariate analysis, turf.

Introduction

Browntop in Europe or Colonial bentgrass in United States (*Agrostis capillaris* L. 2n=4x=28), native to Europe and temperate Asia, is commonly used for tennis courts, high-grade lawns, fairways and erosion control (Hubbard, 1984).

To conserve and study the existing genetic resources of colonial bentgrass Northern Spanish accessions for use in breeding was investigated using amplified fragment length polymorphism (AFLP) markers (Zhao *et al.*, 2006).

Objective of this research was to characterise the variability of northern Spanish *Agrostis capillaris* accessions, on the basis of morphological characteristics. Knowledge of this variability should provide useful information concerning the potential value of these accessions to Spanish and North American breeding programs.

Materials and methods

Originally, seed of 14 colonial bentgrass accessions was collected from grasslands in northern Spain. The morphological study was established at the University of Oviedo in a farm of the community of Carreño (43° 35' N, 5° 47' W, 90 m.a.s.l., on an inceptisol soil type). The trial was arranged in a randomized complete block design with two replications of 15 plants per accession. Plants were transplanted to the field in March 2003, 50 cm apart. One commercial cultivar 'Golfin' (*Agrostis capillaris*) was also included as control.

The site received the same amount of fertilizer throughout the two years of study, a total of 10 g N m² per year. The plants were maintained at mowing height of 5 cm with a rotary mower.

A total of eleven morphological traits including (1) leaf width (1=narrow to 9=broad), (2) growth habit (1=erect to 9=prostrate), (3) colour (1=light green to 9=dark green), (4) autumn growth (1=very little to 9=very green), (5) winter growth (1=very little to 9=very green), (6) flag leaf length in centimetres, (7) flag leaf width in millimetres, (8) length of longest stem, included inflorescence, in centimetres, (9)

Length inflorescence, in centimetres, (10) length upper internode, in centimetres, (11) heading date as the number of days after January the first. These traits were evaluated during a 2-year period. Analysis of variance of the morphological data was performed first per year and to observe errors homogeneity to combine the statistical analysis for the two years. Multivariate relationships among entries were revealed with a principal component analysis (PCA) using a correlation matrix derived from the significant characters. The original variables were reduced to four independent linear combinations, principle components (PC) of the variables, with eigenvalues greater than 1. These PCs were used as the input for an agglomerative hierarchical clustering analysis to detect groups of similar agromorphological types. The squared Euclidean distance was the measure of distance, and the Ward's clustering algorithm, was the method for combining entries into clusters. With the purpose to examine differences between the clusters obtained, a table of means, standard deviations and the results of a one-way ANOVA (F tests) are also presented. Statistical analyses were computed using SPSS 11.5 (SPSS, 2002).

Results and discussion

The data set was reduced to four principle components that cumulatively explained 82.6% of the total variance.

Hierarchical clustering analysis performed on the first four principal components leads to a dendrogram that was cut at the four cluster level describing 57% of the phenotypic variation among entries.

Significant statistical differences were detected between clusters for growth habit, colour, flag leaf width, length of upper internodes and heading date (Table 1).

Table 1. Between-Groups differences for leaf width (Lw), growth habit (Gh), colour (Co), autumn growth (Ag), winter growth (Wg), flag leaf length (Fl), flag leaf width (Flw), length of longest stem (Lls), length inflorescence (Lin), length upper internodes (Lui) and heading date (Hd) traits. M = mean, SD = Standard deviation. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, NS = $p > 0.05$.

Trait	Group 1 (n = 7)		Group 2 (n = 3)		Group 3 (n = 2)		Group 4 (n = 3)		Anova F ratios
	M	SD	M	SD	M	SD	M	SD	F (3,11)
Lw	6.19	0.66	6.57	0.40	5.95	0.05	6.00	0.73	0.5NS
Gh	4.13	0.24	3.10	0.08	3.85	0.05	3.27	0.05	24.4***
Co	6.49	0.45	6.87	0.05	6.90	0.00	5.33	0.47	8.0**
Ag	6.36	0.54	6.43	0.31	5.40	1.20	5.27	0.90	1.8NS
Wg	6.49	0.56	6.90	0.71	5.90	1.20	6.13	0.87	0.6NS
Fl	7.66	1.95	8.37	1.45	10.80	1.20	7.13	1.77	1.5NS
Flw	3.39	0.61	3.40	0.41	5.10	0.40	4.73	0.54	7.0**
Lls	63.54	5.36	68.23	5.43	74.70	2.90	59.60	3.50	3.4NS
Lin	11.70	2.12	12.50	1.72	16.55	3.35	10.43	2.17	2.3NS
Lui	9.86	1.19	11.87	0.79	14.35	0.85	10.23	0.49	9.3**
Hd	158.29	1.90	159.67	0.47	147.50	0.50	155.00	2.94	15.4***

Cluster 1 consisted of seven accessions with an intermediate growth habit, late heading and with the narrowest flag leaf and shortest upper internodes. Cluster 2 contained three accessions with the latest heading, the most erect growth habit, darkest green colour as accessions of cluster 3. Cluster 3 contained the two earliest heading accessions and the widest flag leaf and longest upper internodes. Cluster 4 consisted of two accessions and the cultivar lightest green colour and intermediate characters among the other clusters.

Certain colonial bentgrass accessions are widely recognized as having good resistance to snow mold (Vergara and Bughrara, 2005) and dollar spot (Belanguer *et al.*, 2004). For this reason we are now evaluating the susceptibility to two important turf diseases (snow mold and dollar spot) on these accessions.

Conclusions

The assessment of the morphological diversity among North Spanish colonial bentgrass accessions suggested the potential value of this germplasm in turfgrass cultivar improvement.

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