DIFFERENCES BETWEEN ADAPTED POPULATIONS OF *DACTYLIS GLOMERATA* L. IN ARGENTINA

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ABSTRACT

Nine adapted populations of orchardgrass (*Dactylis glomerata* L.) were collected from different grassland environments of Buenos Aires Province, Argentina, in order to investigate genetic differences between and within populations. Fifty plants per population were clonally propagated and transplanted as spaced-plant trial in a randomized design with three replicates. The results indicated large differences between and within populations for most attributes measured. Attributes related with the expression of foliar diseases and seed yield had the highest broad-sense heritability values. The results suggest that the genetic variation found in the adapted populations of orchardgrass has been mainly determined by the environmental heterogeneity of the original habitats.

KEYWORDS

Genetic variability, orchardgrass, environmental heterogeneity.

INTRODUCTION

Orchardgrass is one of the most important perennial grasses used in intensive forage systems of the Buenos Aires Province. However the cultivars introduced from abroad have shown some constraints in seed yield, foliar diseases and persistency, mainly due to a lack of adaptation. There is ample evidence that population differentiation occurs within grass species (Snaydon, 1987; Briggs and Walters, 1989; Andres and Cordero, 1995); both in morphology and in physiology, as an adaptive strategy in response to selective processes. This population differentiation has been shown in response to climate, soil conditions, and defoliation. On the other hand ecotypes are often used in plant breeding to develop new varieties. The objective of this work was to evaluate the genetic differences between adapted populations of orchardgrass as an introductory part of a breeding programme in progress at our Institute. The final aim of this programme is to provide new cultivars of orchardgrass, adapted to different management systems.

METHODS

Nine populations of orchardgrass were collected during autumn 1994 from different grassland environments of Buenos Aires Province, including new pastures grazed continuously by cattle, old pastures grazed by cattle or sheep, and an old park grassland frequently mowed. Each population was randomly sampled by taking ramets from fifty plants. The ramets were transfered to Pergamino Experimental Station, transplanted into pots of compost and grown in a cool greenhouse to vegetatively increase the material and reduce any carry-over effects. The plants were broken down into three ramets, and transplanted 0.60 m apart in a randomized block design with three replicates. The attributes measured were: growth habit (GH), plant diameter (PD), flowering date (FD), leaf color (LC), leaf width (LW), plant height at harvest (PH), number of panicles (NP), panicle length (PL), number of branches/panicle (NB), regrowth dry weight (RDW), infection coefficient (IC), stem rust percentage (SR), total seed weight (TSW), 1000 seed weight (OSW). Statistical analyses were performed on each attribute by using the SAS programme (SAS Institute Inc., 1989), considering a nested analysis for populations and genotypes. The genetic parameters estimated were: genetic variance (GV), environmental variance (EV), genetic variation coefficient (GVC) and broad sense heritability (H).

RESULTS AND DISCUSSION

There were significant differences between populations for all attributes measured (Table 1). The differences were mainly related with the grazing/cutting regime in the original habitats. Populations 1 and 2 were collected in Pergamino from pastures sown with an old Argentinian cultivar very susceptible to foliar diseases. They were light green, late flowering and had short panicles, though plants from population 1 were less affected by diseases than plants from population 2, probably due to artificial selection made by farmers. Populations 8 and 9 were blue green, medium flowering, and produced high number of panicles with many branches, but they significantly differed in plant height and in regrowth yield (Table 1). Although both populations were collected in Balcarce from pastures sown with the same European cultivar, they were continuously grazed by cattle (population 8) and by sheep (population 9). Many animals, especially sheep and goats grazed selectively, and have different preference, which may also differ between seasons, increasing genetic variation and population differentiation (Arnold, 1981). Populations 3 and 4 were sampled from the same ecological area, though population 3 came from a new pasture grazed laxly by cattle, and population 4 came from an old park grassland frequently mowed. They had short and postrate plants, but those collected from the park flowered earlier and produced lower number of panicles with high branching than plants collected from the pasture (Table 1). Similarly, plants from populations 6 and 7 came from pastures sown in the same ecological area, but under infrequent and continuous grazing, respectively. They were grey-green, semi-erect with high number of panicles, though they significantly differed in flowering date and panicle length (Table 1).The frequency and intensity of defoliation, either by grazing or cutting, has a variety of physiological effects on the plant, particularly on flowering behaviour (Vickery, 1981), and it may have a large effect on the genetic structure of populations (Snaydon, 1987). Significant differences were also found within populations, though populations 2 and 6 showed remarkably little variation. Similarly the heritability varied according with the population and the attribute considered (Table 2). Populations 5 and 8 had the largest estimators, while populations 2, 6 and 7 had the lowest. Some attributes, like total seed weight, regrowth dry weight and stem rust percentage had the largest heritability values. The differences found may indicate that the individuals and populations have been subjected to different selection pressures in their original habitats.

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Table 1
Mean performance of orchardgrass populations grown under spaced-plant conditions.

Site	Pop.	LH	GH	PD	FD	PH	NP	PL	NB	RDW	SR	IC	TSW	OSW	LW
		%		cm		cm		cm		(g)	%		g		cm
Pergamino	1	52.9	59.7	36.8	119.3	76.7	14.4	17.4	16.5	37.0	19.0	7.1	3.3	0.8	0.6
	2	48.5	44.3	-	119.2	80.8	10.0	16.8	15.3	-	-	-	-	-	-
Villegas	3	60.8	66.6	40.8	116.8	78.4	18.1	21.0	16.4	-	-	-	-	-	-
	4	56.1	63.9	42.7	109.7	77.5	16.0	19.6	18.0	32.9	49.7	10.8	5.0	0.8	0.6
Bolivar	5	57.8	59.9	47.5	114.0	75.2	15.8	19.9	17.6	32.6	29.8	10.5	2.8	0.8	0.6
San	6	58.0	57.2	44.2	122.5	76.8	18.5	19.9	16.3	-	-	-	-	-	-
Antonio	7	56.8	55.5	42.3	114.7	82.1	20.3	21.3	16.3	-	-	-	-	-	-
Balcarce	8	64.1	54.7	44.2	114.1	80.3	22.0	20.6	17.5	56.9	22.0	8.5	3.1	0.6	0.6
	9	63.5	62.1	41.3	116.6	75.5	18.3	19.8	17.6	42.6	25.3	9.5	2.9	0.7	0.6
LSD(0.05)		4.6	5.8	2.6		3.3		1.19		9.5	4.2	1.1			0.03
LSR(0.05)					1.03		1.22		1.02				1.6	1.1	

Table 2
Heritabilities of various attributes of orchardgrass populations

Site	Pop.	PD	FD	PH	NP	PL	NB	LC	GH	RDW	SR	IC	TSW	LW	OSW
Pergamino	1	0.26	0.40	0.21	0.39	0.20	0.18	0.06	0.27	0.44	0.60	0.28	0.49	0.21	0.25
	2	—	0.01	0.32	0.00	0.11	0.04	0.03	0.23	-	-	-	-	-	-
Villegas	3	0.32	0.51	0.52	0.36	0.38	0.48	0.14	0.15	-	-	-	-	-	-
	4	0.17	0.34	0.57	0.46	0.42	0.24	0.18	0.12	0.16	0.33	0.00	0.61	0.33	0.15
Bolivar	5	0.07	0.37	0.15	0.31	0.43	0.11	0.19	0.41	0.60	0.65	0.21	0.40	0.44	0.65
San	6	0.02	0.06	0.24	0.17	0.10	0.00	0.17	0.27	-	-	-	-	-	-
Antonio	7	0.15	0.14	0.29	0.32	0.12	0.11	0.22	0.10	-	-	-	-	-	-
Balcarce	8	0.24	0.53	0.49	0.49	0.36	0.19	0.12	0.16	0.54	0.80	0.09	0.41	0.11	0.57
	9	0.14	0.29	0.25	0.29	0.17	0.25	0.14	0.01	0.42	0.53	0.46	0.20	0.11	0.45