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GENETIC VARIABILITY WITHIN TWO ADAPTED POPULATIONS OF TALL WHEATGRASS *(THYNOPYRUM PONTICUM)* IN ARGENTINA

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Abstract

The genetic variability within two adapted populations of tall wheatgrass (*Thinopyrum ponticum*) was evaluated in Argentina, 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 tall wheatgrass, adapted to different management systems. Two hundred fifty plants per population were grown from seeds, clonally propagated and transplanted as a spaced-plant trial in a randomized design with three replicates. The results indicated large differences between genotypes within the two populations for most attributes measured, though there were no significant differences between populations. Attributes related with forage yield, forage quality and seed production had high to medium broad-sense heritability values, suggesting the importance of including the adapted germoplasm in the breeding programme in progress at INTA.

Keywords: genetic variability, breeding programme, tall wheatgrass

Introduction

Tall wheatgrass is one of the most important perennial grasses used in waterlogged and salines soils of the Argentinian “pampa”. However the breeding of the species has received little attention. There is ample evidence that genetic variability occurs within grass species (Snaydon, 1987; Andrés and Barufaldi, 1997), both in morphology and in physiology. The amount of genetic variation within clearly defined populations can often be in response to ecological factors such as animal excreta, soil conditions and defoliation (McNeilly and Roose, 1984; Vrijenhoek, 1990). As a result, the variation of attributes related with yield potential, quality and adaptation to different management systems, is often used in plant breeding to develop new varieties. The objective of this work was to evaluate the genetic variability within two populations of tall wheatgrass adapted to different grassland environments in the Buenos Aires province, as an introductory part of a breeding programme in progress at INTA. The final aim of this programme is to provide new cultivars of tall wheatgrass adapted to different management systems.

Material and Methods

Two adapted populations of tall wheatgrass were grown from seeds in a cool greenhouse during the autumn of 1998. At the stage of four tillers, two hundred and fifty plants were randomly sampled from each population. Each plant was transplanted into pots with compost and grown in a cool greenhouse to vegetatively increase the material. The plants were broken down into three ramets and transplanted 0.60m apart in a randomized block design with three replicates, at the experimental grounds of a plant breeding company (GENTOS SA) located at Pergamino (Buenos Aires), during the winter of 1998. All plants were measured or scored for a range of morphological attributes: tiller number (TN) (4/9;

10/11), leaf width (LW), leaf color (LC), vigor (V), softness (S), regrowth heigth (RH) (5/5; 10/7; 16/9), dry matter yield (DMY) (20/4; 25/6; 1/9), flowering date (FD), spike length (SL), spike number (SN), *in vitro* dry matter digestibility (IVDDM) (20/4/99), seed yield (SY). Statistical analyses were performed on each attribute by using the SAS programme (SAS Institute Inc., 1989). Genetic parameters estimated were: genetic variance (σ^2G), environmental variance (σ^2E) and degree of genetic determination (GDG).

Results and Discussion

Tall wheatgrass is naturalized and established in several environmets of the "pampa" grasslands, which have resulted in the formation of ecotypes with differences in their morphology and physiology (Borrajo et al, 1997). Surprisingly, no significant differences were found between the two adapted populations, for any of the attributes measured (Table 1). Relatively few papers have described such lack of differentiation between populations (Van Dijk et al., 1988). One reason may be that ecotypic differentiation is truly common and that few cases exist where no ecotypic differentiation occurs within species with wide ecological amplitude. Another reason may be that population differentiation will not take place when morphological and physiological responses by individuals allow them to withstand the full environment. The results of the present study showed that there was considerable genetic variation between genotypes within both populations (Table 2), and that probably diluted the interpopulation differences. The large intrapopulation variability was reflected in the largest heritability values of most attributes (Table 2). When environmental heterogeneity occurs over short distances or with a frequency similar to lifespan of individual plants, it acts as disruptive selection, commonly giving rise to polymorphism. In perennial species considerable genetic variation has been detected within small areas (McNeilly and Roose, 1984), caused by ecological factors, such as animal excreta, fertilizers and defoliation. Relatively little

information is available on heritability values of agronomic attributes of tall wheatgrass. The evidence for high GDG values given by the present study may have an important applicabilility to the current breeding programme. Attributes related with forage yield and IVDDM during autumn had very high heritability values indicaiting that there should therefore be good possibilities of developing high yielding varieties from the germplasm of the two adapted populations.

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Table 1- Mean performance of tall wheatgras populations grown under spaced - plant conditions

	TN (4/9)	TN (10/11)	LW (1...5)	LC (1...4)	V (1...5)	S (1...3)	RH (5/5) (cm)	RH (10/7) (cm)	RH (16/9) (cm)	DMY (20/4) (g/pl)	DMY (25/6) (g/pl)	DMY (1/9) (g/pl)	FD (days transp)	SL (cm)	SN	SY (g/pl)	IVDDM (20/4)
Pop A	12.05 ± 6.97	56.351 ± 33.061	3.367 ± 0.991	2.934 ± 0.942	2.759 ± 1.250	1.509 ± 0.753	27.064 ± 6.003	43.526 ± 9.644	44.272 ± 8.612	23.709 ± 12.823	42.02 ± 27.86	41.44 ± 24.27	142.581 ± 1.146	36.57 ± 6.312	59.491 ± 29.752	34.42 ± 24.3	66.25 ± 1.40
Pop B	14.2 ± 7.147	58.716 ± 30.468	1.473 ± 0.755	2.959 ± 0.878	2.987 ± 1.28	1.473 ± 0.755	26.345 ± 5.714	38.343 ± 8.461	44.856 ± 8.75	21.119 ± 11.732	39.94 ± 27.58	34.73 ± 20.64	140.819 ± 9.626	37.58 ± 5.589	57.345 ± 27.558	38 ± 25.7	65.97 ± 1.41
Mean	13.113 ± 7.15	57.559 ± 31.8	3.302 ± 1	2.947 ± 0.91	2.871 ± 1.26	1.491 ± 0.75	26.705 ± 5.87	40.938 ± 9.44	44.566 ± 8.69	22.418 ± 12.36	40.98 ± 27.46	38.08 ± 22.77	141.7 ± 9.93	37.07 ± 5.98	58.405 ± 28.65	36.2 ± 25.07	66.11 ± 1.68
Test F	ns	ns	ns	ns	ns	ns	ns	ns	*	ns	ns	ns	Ns	ns	*	ns	ns

Table 2 - Heritabilities of various attributes of two tall wheatgrass populations

		TN (4/9)	TN (10/11))	LW (1...5)	LC (1...4)	V (1...5)	S (1...3)	RH (5/5)	RH (10/7)	RH (10/9)	DMY (20/4)	DMY (25/6)	DMY (1/9)	FD	SL	SN	SY	IVDDM (20/4)
Pop A	σ^2G	13.185	489.658	0.387	1.505	0.879	1.11	53.309	39.38	27.68	62.698	166.53	164.18	34.44	16.9	460.959	263.02	5.445
	σ^2F	47.46	1033.02	0.84	1.976	1.52	1.359	76.78	91.18	73.118	162.644	755.36	580.71	103.081	39.72	884.519	591.05	9.354
	GDG	0.28	0.47	0.46	0.76	0.58	0.82	0.69	0.43	0.38	0.38	0.22	0.28	0.33		0.52	0.44	0.58
Pop B	σ^2G	16.516	423.31	0.336	0.33	0.9	0.336	11,11	22.035	28.97	39.04	161	109.64	27.33	14.25	348.6	293.5	8.634
	σ^2F	50.435	855.75	0.91	0.76	1,62	0.571	32.25	70.52	76.22	137.69	728.78	410.72	92.27	30.75	743.98	645.49	12.623
	GDG	0.33	0.49	0.43	0.43	0.55	0.59	0.34	0.31	0.38	0.28	0,22	0,27	0.3	0.46	0.47	0.45	0.68

σ^2G: genetic variance
σ^2F: phenotypic variance
GDG: degree of genetic determination