

BETA-GLUCAN CONTENT IN SOUTHERN BRAZILIAN OAT CULTIVARS AND ENVIRONMENTS^S



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Introduction

β-Glucans are the main soluble fiber in oats, and are one of the constituents of the cell wall. β-Glucans are associated with human health benefits, such as the reduction of blood cholesterol and heart disease risk. β-Glucan content in oats is known to be affected by the environment, even though how the environment affects it is not well understood. This work aimed to measure β-glucan content in Brazilian oat (*Avena sativa* L.) genotypes under different Southern Brazilian environments and to study stability and adaptability parameters for these genotypes and this trait.

Material and Methods

Years: 2010 and 2011

Locations: three Southern Brazilian environments, see Figure 1

Treatments: sowing dates { Into the best sowing window at the three location
Out of the best sowing window at one location (Eld. do Sul)

15 oat genotypes { 2 older UFRGS cultivars (UFRGS 7 and UFRGS 14)
11 moderns UFRGS cultivars, released from 2000 to 2011 (see Table 1)
(*Avena sativa* L.) { 2 UFRGS lines { UFRGS 049001-2 (hullless)
UFRGS 087313-1 (forage type, no UFRGS germoplasm)

Experimental design: randomized blocks, three replications per trial

Beta-glucan data: • 50 g sample of grains, per plot, was mechanically dehulled
• 300 integral groats ground in a bench grinder and then sieved
• Homogenized flower samples were analysed in Near Infrared (NIR) Spectrometer (Perstorp Analytical, Maryland, EUA, model 5000), at the Research Center for Food (CEPA), from the University of Passo Fundo (UPF), Brazil

Statistical analysis:

• analysis of variance
• analysis of adaptability and stability (Eberhart and Russel, 1966).

adaptability → regression coefficient (b) ≠ 1
stability → linear regression deviations (σ_a^2) as small as possible

predictability → high R² (Cruz and Regazzi, 1994)

Ideal genotype = ↑ mean, ↑ stability, ↑ adaptability



Figure 1. Locations where oats were grown in Rio Grande do Sul, Brazil.

RESULTS

Analysis of variance

No Genotype x Environment interaction

Genotype and Environment individual effects were significant

Table 1. Analysis of variance of beta-glucan content in Brazilian oat genotypes and Southern Brazilian environments.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean of Squares	F Value	Pr > F
Replicates / Environment	16	6.4516683	0.40322927	0.66	0.8330
Environment	5	78.052304	15.61046077	25.46	<.0001
Genotype	14	59.431822	4.24513017	6.92	<.0001
Genotype * Environment	66	44.65039	0.67652106	1.1	0.2986
Error	204	125.07574	0.6131164		
Total	305	321.66897			

Adaptability and stability analysis

Table 2. Adaptability and stability analysis of oat beta-glucan content across six Southern Brazilian environments, according to the Eberhart and Russel (1966) methodology.

Genotype	Observed beta-glucan mean	Estimated beta-glucan mean (Intercept)	Regression coefficient (b)	t test for h ₀ : b=1 Prob > t	t teste for h ₀ : b=0 Prob > t	F Test for h ₀ : σ _a ² > 0 Adjuted Prob > F	R ²
UFRGS 049001-2	4.75	4.74	0.392	0.067	0.1819	-0.08321	0.964
UFRGS 087313-1	5.67	5.95	0.865	0.787	0.1865	-0.10468	0.893
UFRGS 14	6.05	6.07	1.273	0.234	0.0028	-0.11556	0.984
UFRGS 7	6.13	6.13	0.401	0.190	0.3512	0.04798	0.835
URS 21	5.79	5.81	1.391	0.319	0.0156	0.00794	0.880
URS 22	5.66	5.68	1.033	0.746	0.0004	-0.15986	0.999
URS Charrua	6.17	6.20	1.252	0.295	0.0039	-0.10661	0.979
URS Corona	6.19	6.15	1.107	0.710	0.0146	-0.06308	0.948
URS Guapa	6.59	6.58	0.604	0.516	0.3397	0.30275	0.541
URS Guará	6.57	6.55	1.044	0.921	0.0645	0.08692	0.790
URS Guria	6.46	6.51	1.307	0.470	0.0275	0.05420	0.828
URS Penca	5.87	5.91	0.635	0.126	0.0284	-0.11903	0.986
URS Tarimba	6.46	6.39	1.052	0.449	0.2171	0.29917	0.545
URS Taura	5.63	5.63	1.078	0.893	0.1178	0.27787	0.568
URS Torena	6.07	6.05	1.659	0.100	0.0059	-0.02662	0.915
Mean	6.00	6.02	1.007			0.01988	0.57

RESULTS

Beta-glucan mean performance

Genotypes with highest means: URS Guapa, URS Guria, URS Guará and URS Tarimba

Table 3. Year of cultivar release, grain yield means per environment, oat beta-glucan content minimum (Min.), mean, maximum (Max.) and standard deviation (St. Dev.) of genotypes and environments, based on means per environment and on single plot performances.

Genotype	Year of release	Beta-glucan content based on mean performance / environ.				Beta-glucan content based on plot performance			
		Min.	Mean	Max.	St. Dev.	Min.	Mean	Max.	St. Dev.
UFRGS 049001-2		4.07	4.72	5.01	0.35	3.81	4.75	5.85	0.59
UFRGS 087313-1		5.11	5.64	5.91	0.37	4.06	5.67	7.51	0.93
UFRGS 14	1993	5.15	5.99	7.06	0.74	4.51	6.05	8.06	0.98
UFRGS 7	1985	5.45	6.11	6.70	0.48	4.96	6.13	7.18	0.74
URS 21	2000	4.86	5.73	7.25	0.86	4.30	5.79	7.68	0.97
URS 22	2001	4.95	5.62	6.36	0.58	3.88	5.66	7.41	0.88
URS Charrua	2010	5.15	6.13	7.15	0.73	4.87	6.17	8.20	0.89
URS Corona	2010	5.33	6.09	7.05	0.68	4.78	6.19	7.79	0.88
URS Guapa	2004	5.88	6.55	7.62	0.70	5.12	6.59	8.66	1.06
URS Guará	2011	5.60	6.49	7.25	0.74	4.95	6.57	8.64	0.94
URS Guria	2010	5.08	6.44	7.29	0.84	4.66	6.46	8.61	1.07
URS Penca	2011	5.35	5.87	6.25	0.41	4.25	5.87	7.41	0.76
URS Tarimba	2009	5.32	6.40	7.51	0.90	4.70	6.46	8.32	1.22
URS Taura	2009	3.95	5.57	6.38	0.85	3.64	5.63	7.67	1.05
URS Torena	2010	4.45	5.95	7.25	0.98	4.24	6.07	7.67	1.04
General Mean		5.05	5.95	6.80	0.68	4.45	5.99	7.78	0.93
Coef. of Variat. (%)			7.57				13.06		
Environment*									
CA2010	4522	3.95	5.22	6.97	0.81	3.64	5.22	7.24	0.93
Vac2010	4768	4.63	5.73	6.88	0.55	4.06	5.68	7.56	0.84
Eld10Sd1	2707	4.93	5.56	5.99	0.32	4.14	5.56	6.92	0.63
Eld10Sd2	2281	5.01	6.06	6.95	0.45	4.21	6.06	7.45	0.72
Eld11Sd1	4399	4.72	6.50	7.29	0.70	4.32	6.48	8.64	1.02
Eld11Sd2	1275	4.94	6.69	7.62	0.73	3.81	6.64	8.66	1.07
General Mean	3184	4.70	5.95	6.95	0.59	4.03	6.00	7.75	0.87

*CA2010 = Cruz Alta 2010; Vac2010 = Vacaria 2010; Eld10Sd1 = Eldorado do Sul 2010, 1st sowing date; Eld10Sd2 = Eldorado do Sul 2010, 2nd sowing date; Eld11Sd1 = Eldorado do Sul 2011, 1st sowing date; Eld11Sd2 = Eldorado do Sul 2011, 2nd sowing date.

Beta-glucan mean and adaptability

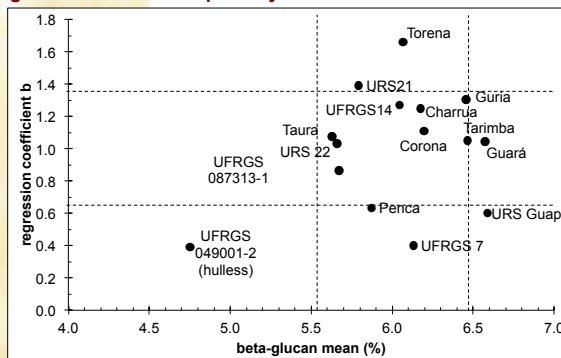


Figure 2. Association between beta-glucan content mean and the adaptability parameter b (coefficient of regression) of 15 oat genotypes cultivated on six Southern Brazilian environments in 2010 and 2011, being constituted by locations and sowing dates. (dashed lines represent values equal to the mean plus or minus one standard deviation for beta-glucan mean and for the linear regression coefficient).

Conclusions

- UFRGS oat cultivars present adequate beta-glucan levels, tending to be agronomically stable over environments and do not show genotype by environment interaction;
- Poorer grain yield environments tended to give the highest beta-glucan averages;
- Predictability of beta-glucans content across environments varies among genotypes but some, such as URS 22, UFRGS 14, URS Charrua and URS Torena are quite predictable;
- Considering all of the parameters together (mean, adaptability (b), stability (σ_a²) and predictability (R²)), the best oat genotypes were URS Charrua, UFRGS 14, URS Corona and URS Guria.