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Barbarasul: a high-yielding and lodging-resistant white oat cultivar

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ABSTRACT – *The white-oat cultivar Barbarasul was developed by the Universidade Federal de Pelotas. It resulted from a cross between UPF18 and CTC5. It is adapted to the southern region of Brazil, with excellent grain yield potential, short stature and high lodging tolerance.*

Key words: *Avena sativa* L., hexaploid oat, crop breeding.

INTRODUCTION

The importance of white oat (*Avena sativa* L.) has increased in the last few years, with a steep increase in cultivated area to meet the industry demand. Due to health benefits, such as the reducing effect of b-glucan on blood cholesterol levels, the crop has been integrated in the human food chain (Finatto et al. 2007). The integration of white oats in production systems also allows an improvement of soil physical, chemical and biological properties, reduction of pests and diseases in other crops and allelopathic weed control (Jacobi and Fleck 2000, Fontanelli et al. 2000).

The Brazilian production reached 221.8 thousand tons in 2007. This is a small amount, compared to other cereals such as wheat (3,824 thousand tons) or rice (12,284 thousand tons), although increases have been constant in the last few years (Conab 2008). This is due to the development of higher yielding cultivars, adapted to Brazilian climate and soil conditions (Barbosa-Neto et al. 2000).

The success of white oat is strongly associated to the adaptation of new genotypes to environmental conditions and stabilization of grain yield in different productions systems (Carvalho et al. 1987). In this sense, breeders from different research institutes are constantly working towards a better ideotype, focusing on yield stability, disease resistance and grain quality.

Oat breeding has gone though distinct periods in Southern Brazil. In the beginning, long-cycle cultivars, high stature and low yields were frequent. Later, the introduction of lines through the exchange with

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international institutes resulted in higher grain quality, shorter plant stature and higher grain yield. These crop advances were followed by the development of genotypes at local institutes, i.e., Federal University of Rio Grande do Sul (UFRGS) and Passo Fundo (UPF). In these genotypes the plant architecture is new, the cycle shorter, grain quality higher and the grain yield potential particularly high (Carvalho and Federizzi 1989, Barbosa-Neto et al. 2000).

The participation of the Universidade Federal de Pelotas (UFPel) in oat research and breeding has been intensive, resulting in a series of research papers and the release of new oat varieties, such as Albasul, released in 2003. This high-yielding cultivar is currently grown in southern Brazil.

PEDIGREE AND BREEDING METHOD

The oat cultivar Barbarasul was obtained from the cross UPF18 x CTC5, in March 2000, in Pelotas, RS, Brazil. The F_1 generation was grown in the late winter in a nethouse. The F_2 generation was grown in an experimental field of the Crop Science Department, UFPel. Spaced plants of this generation were grown and the best plants selected. In the summer 2001/2002, F_3 seeds from selected plants were sown in a nethouse to grow the F_4 generation. This generation was sown in the field (winter 2002) where the best lines were selected. Selected F_5 lines were sown at standard seeding density (300 viable seeds per square meter) in the winter 2003, where lines were selected. In the 2004 growing season, since the lines were highly homozygous and regular, the best lines were evaluated in an internal preliminary grain yield trial in Pelotas, RS. Three genotypes (indicated by the Brazilian oat research committee) were used as control. At this point the genotype was temporarily designated UFPel 0308.

PERFORMANCE

In 2005, the cultivar Barbarasul was introduced in the Regional Line Trial (ERLA) and in the years 2006 and 2007, in the Brazilian Line Trial (EBLA), coordinated by the Brazilian Oat Research Committe (CBPA). Other trials were also conducted in Passo Fundo, RS, in association with the Fundação Pró-Sementes. According to the CBPA guidelines, the decision for a release is based on a comparison of the mean performance of three consecutive years (first year in ERLA and two years in EBLA), at a number of locations, with the performance of the best control cultivars of each year. Lines with a grain yield of at least 5% of the mean grain yield of the best control in the mean of three years may be released for commercial planting. Another possible condition for release could be a mean grain yield between 100 and 105% of the best control mean, if there is some special trait, e.g., good lodging resistance, or if the release addresses a specific region or location, i. e., when the grain yield of a line is 10% above the best control at one location only.

In the years 2006 and 2007 trials of distinctiveness, homogeneity and stability (DHE) were conducted in Pelotas, Rio Grande do Sul, and the cultivars Albasul, UPF18 and UPFA22-Temprana were used as comparison.

The mean grain yield of Barbarasul, in three years of evaluation, was 2.3% higher than the mean of the best control. The plant stature was also excellent (97.3 cm), 5% shorter than the highest-yielding control (URS Guapa) (Table 1). Also, Barbarasul has a cycle of 118 days from emergence to maturation, with a six day longer cycle than URS 21 and equal performance to URS Guapa. In the mean of three years, the hectoliter weight was 44.8 kg hL^{-1}, which outmatches URS Guapa and is only exceeded by URS 21 (46 kg hL^{-1}). On the other hand, the weight of 1000 grains was 26.3g (Table 1), exceeding the performance of cultivar UPF 18 (24.9 g). This is due to a high tillering potential of Barbarasul, with a compensating effect on grain yield components.

The production of cultivars with grains of high physical quality has increased in importance, especially with the globalization of South American markets (Cabral et al. 2001, Kolchinski and Schuch 2004). In this sense, some physical traits that confer higher grain quality are receiving special attention in oat breeding programs, with a particular focus on percentage of grains thicker than 2 mm, dehulling index and milling yield; grain yield potential and milling yield must be associated. The performance of Barbarasul for the traits grain thicker >2mm (77.20%) and milling yield (55.05%), compared to the control cultivars UPF 18, UPFA 22, URS 21 and URS Guapa was very good (Table 2).

Barbarasul is an excellent alternative for cultivaton of white oat in southern Brazil and can be used either for the food and feed industry or in crop rotation systems, as biomass and/or cover crop. Since

it does not have any thermal or photoperiod requirements, is is suitable for cultivation in the numerous regions where this grain cereal is produced. With respect to the main diseases, the cultivar was classified as moderately susceptible to leaf rust, moderately tolerant to barley yellow dwarf virus, and resistant to stem rust.

SEED MAINTENANCE AND DISTRIBUTION

Barbarasul is registered by the Ministério da Agricultura Pecuária e Abastecimento (MAPA), no. 21517. The UFPel is in charge of the genetic and basic seed stock of the cultivar and certified seeds are licensed by Fundaçao Pró-Sementes.

Table 1. Means of cultivar Barbarasul and four control cultivars for five traits evaluated for three years at distinct locations, coordinated by the Brazilian Oat Research Committe in 2005, 2006 and 2007

Genotypes	2005 (%BC)	2006 (%BC)	2007 (%BC)	Mean	Mean %BC*
	Days from emergence to maturation				
Barbarasul	122 (105.3)	113 (104.3)	122 (106.7)	118.9	105.5
UPF 18 (C)	125 (108.5)	115 (106.0)	-	120.1	107.3
UPFA 22 (C)	116 (100.0)	108 (100.0)	114 (100.0)	112.7	100
URS 21 (C)	121 (105.0)	111 (102.4)	117 (102.2)	116.3	103.2
URS Guapa (C)	-	-	118 (103.7)	118.4	103.7
	Plant stature (cm)				
Barbarasul	102 (97.3)	104 (100.4)	86 (105.2)	97.3	101
UPF 18 (C)	120 (114.2)	112 (108.2)	-	115.7	111.2
UPFA 22 (C)	105 (100.0)	103 (100.0)	82 (100.0)	96.7	100
URS 21 (C)	115 (109.7)	112 (108.4)	94 (114.5)	106.9	110.8
URS Guapa (C)	-	-	87 (106.0)	86.9	106
	Hectoliter weight ($Kg.hl^{-1}$)				
Barbarasul	42.1 (91.0)	45.8 (100.6)	46.4 (100.5)	44.8	97.4
UPF 18 (C)	33.1(71.4)	32.8(71.4)	-	32.9	71.7
UPFA 22 (C)	38.2 (82.5)	39.1 (86.0)	43.7 (94.5)	40.3	87.6
URS 21 (C)	46.3 (100.0)	45.5 (100.0)	46.2 (100.0)	46	100
URS Guapa (C)	-	-	43.5 (94.1)	43.5	94.1
	Weight of 1000 grains (g)				
Barbarasul	26.5 (92.7)	25.8 (93.5)	26.6 (85.0)	26.3	90.4
UPF 18 (C)	25.3 (88.5)	24.5 (88.9)	-	24.9	88.7
UPFA 22 (C)	28.6 (100.0)	26.8 (97.2)	29.5 (94.1)	28.3	97.1
URS 21 (C)	28.2 (98.6)	27.6 (100.0)	28 (89.4)	27.9	96
URS Guapa (C)	-	-	31.3 (100.0)	31.3	100
	Grain yield ($kg.ha^{-1}$)				
Barbarasul	2539 (95.7)	2368 (108.7)	2922 (102.4)	2610	102.3
UPF 18 (C)	1459 (55.0)	1158 (53.1)	-	1308	54
UPFA 22 (C)	1864 (70.2)	1404 (64.4)	2089 (73.2)	1786	69.3
URS 21 (C)	2654 (100.0)	2180 (100.0)	2755 (96.6)	2529	98.9
URS Guapa (C)	-	-	2853 (100.0)	2853	100

*BC – Best Control

Table 2. Results from the physical-chemistry analysis of cultivar Barbarasul and four control genotypes for 10 traits

Physical-chemical analyses	Unit	Barbarasul	UPF 18 (C)	UPFA 22 (C)	URS 21 (C)	URS Guapa (C)
Grains thicker than 2mm.	%	77.20	67.6	69.98	61.38	62.71
Dehulling index	%	71.32	69.74	74.56	78.62	70.38
Milling yield	%	55.05	47.14	52.17	48.25	44.13
Humidity	$g.100g^{-1}$	11.11 – 0	8.13 – 0	8.56 – 0	8.65 – 0	8.56 – 0
Dry matter	$g.100g^{-1}$	88.89 – 100	91.87 – 100	91.44 – 100	91.35 – 100	91.44 – 100
Crude protein	$g.100g^{-1}$	13.95 – 15.70	16.85 – 18.34	16.29 – 17.82	17.28 – 18.92	16.85 – 18.75
Ether extract	$g.100g^{-1}$	6.62 – 7.45	5.92 – 6.44	5.90 – 6.45	6.09 – 6.67	5.92 – 6.14
Crude fiber	$g.100g^{-1}$	1.01 – 1.14	1.48 – 1.61	0.97 – 1.06	1.11 – 1.22	1.48 – 1.80
Fixed mineral residue	$g.100g^{-1}$	2.25 – 2.53	2.15 – 2.34	2.08 – 2.28	2.11 – 2.31	2.15 – 2.31
Non-nitrogen extract	$g.100g^{-1}$	65.06 – 73.19	65.48 – 71.27	66.19 – 72. 39	64.75 – 70.88	65.48 – 71.27

Barbarasul: cultivar de aveia branca resistente ao acamamento e com elevado rendimento de grãos

RESUMO – *A cultivar de aveia branca Barbarasul foi desenvolvida pela Universidade Federal de Pelotas. É resultado do cruzamento entre os cultivares UPF18 and CTC5. Possui adaptação para cultivo na região Sul do Brasil, com excelente potencial de rendimento de grão e estatura reduzida, o que lhe confere ótima tolerância ao acamamento.*

Palavras-chave: *Avena sativa* L., aveia hexaplóide, melhoramento genético de plantas.

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