

## URS Altiva – a new oat cultivar with high agro- nomic performance

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**Abstract:** *The oat cultivar URS Altiva, developed from the simple cross 'UFRGS 995090-2 x URS 21', and released by the Oat Breeding Program of the Federal University of Rio Grande do Sul (UFRGS) in 2015, presents high grain yield, high grain quality, desirable agronomic performance, and partial resistance to crown rust.*

**Key words:** *Avena sativa L., oat breeding program, crown rust.*

### INTRODUCTION

The cultivated hexaploid oat (*Avena sativa* L.,  $2n = 6x = 42$ , AACCCDD) is an important cereal crop used for food, feed, and forage worldwide. Oat has several nutritional properties suitable for human consumption, which are associated with health benefits. Oat grains contain high amounts of valuable nutrients, such as proteins, soluble fibers ( $\beta$ -glucans), unsaturated fatty acids, vitamins, minerals, and antioxidants. These attributes make oatmeal a functional food with beneficial effects on lowering cholesterol and reducing glycemic response in humans (Ames et al. 2014).

Oat presents wide adaptation and is cultivated predominantly in temperate regions or in winter seasons. In the Southern Hemisphere, oat cultivation extends from the latitude of 21° (Brazil) to 45° S (New Zealand), while in the Northern Hemisphere, oat is grown from 19° (Mexico) to 65° N (Finland). However, oat production is mainly concentrated between the latitudes 23° and 38° S, and between 35° and 55° N. In subtropical environments, such as Southern Brazil, oat plays an important role for grain production during the winter/spring seasons in no-tillage crop system rotation, usually with soybeans (Locatelli et al. 2007). The area cultivated with hexaploid oat in Brazil was approximately 189.500 hectares with mean grain yield of 1.853 kg ha<sup>-1</sup> in the growing season of 2015. The states of Rio Grande do Sul (RS) and Paraná (PR) were the main oat producers (CONAB 2016).

Oat breeding in Brazil is still recent; it started in the 1970s. The identification of agronomic traits that meet the demand of farmers, industry and final consumers, and their incorporation into elite oat germplasm have been crucial to the development of successful new oat cultivars. Some of the most important traits selected by the UFRGS Oat Breeding Program include wide adaptation, high grain yield and grain quality, short plant cycle, reduced plant height, lodging resistance, frost tolerance, aluminum tolerance, and genetic resistance to the main diseases, such as crown and stem rust, leaf spot, fusarium, and BYDV (barley yellow dwarf virus). The objective of this work is to present the pedigree,

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breeding method, and agronomic performance of the new released oat cultivar URS Altiva.

## PEDIGREE AND BREEDING METHOD

URS Altiva is a hulled  $F_7$ -derived line developed from the simple cross 'UFRGS 995090-2 x URS 21'. Both parents were developed in Brazil by the UFRGS Oat Breeding Program. The genealogy of the parent UFRGS 995090-2 is 'UFRGS 881971 // Pc68/\*5 Starter  $F_4$ ', while the genealogy of the parent URS 21 is 'UFRGS 10 / CTC 84B993'. URS 21 was released as a cultivar in 2000, and has still been cultivated, mainly due to its partial resistance to crown rust, a disease caused by the fungus *Puccinia coronata* Corda f. sp. *avenae*. This genetic resistance enables URS 21 to yield well even in the years which are favorable for the disease development. Crown rust has historically been the major problem in most oat-growing areas in Southern Brazil, causing devastating grain yield losses when using susceptible cultivars, or when chemical control with fungicides is not adequately applied.

The cross between UFRGS 995090-2 and URS 21 was carried out in 2004 at the UFRGS Agronomy Experimental Station, located in Eldorado do Sul, RS, Brazil. The line UFRGS 995090-2 was employed as the female parent and the cultivar URS 21 was employed as the male parent. Artificial hybridization between UFRGS 995090-2 and URS 21 was carried out following the open flower technique, as described by Bertagnolli and Federizzi (1994). Two seeds from the first filial generation ( $F_1$ ) were obtained from this cross, which were sown in the field at the growing season of 2005 under the identification code 'F<sub>1</sub>-67/05'. The number 67 represented the original number of this cross, carried out in 2004. Panicles from the two  $F_1$  plants were harvested and bulk-threshed, giving rise to seeds of the second filial generation ( $F_2$ ).

The segregating population developed from the cross UFRGS 995090-2 x URS 21 was advanced and selected from  $F_2$  to  $F_6$  by means of a modified pedigree method, carried out at the UFRGS Agronomy Experimental Station. The main characteristics and modifications of the breeding method consisted of: i) plant density varied from 25 to 30 seeds per linear meter in the  $F_2$  generation; ii) selection of the best plants started in  $F_2$ , and only one panicle from each selected plant was harvested; iii) selection of the best families started in  $F_{2,3}$ ; iv) each panicle harvested in the previous generation composed a two-meter long double-row in the next generation; v) plant density was determined by the number of seeds present in the previously selected panicle; and vi) all generation was carried out in a no-tillage system, with soybeans as the preceding crop. The main selection criteria used in the field included: vigor and biomass, when plants had 6 to 7 leaves (approximately 40 days after emergence); plant height; number of days to flowering and to maturation; disease resistance; lodging resistance; and panicle fertility at the maturity stage. In the laboratory, traits related to visual grain quality were selected, such as size, shape, uniformity, grain filling, and health.

A population of approximately 600  $F_2$  plants was cultivated in 2006. The population was identified by the number 062062, in which '06' represented the year of 2006, '2' represented the  $F_2$  generation, and '062' represented the evaluated population. From this population, a total of 24 panicles were selected. In the growing season of 2007, these panicles were sown in the field, originating 24  $F_{2,3}$  families, identified with the numbers 073031-1 - 073031-24. From the family 073031-1, six panicles were selected. These panicles were sown in 2008, originating six  $F_{3,4}$  families, and were identified with the numbers 084128-1 - 084128-6. From the family 084128-6, six panicles were selected to compose the next generation.

The  $F_{4,5}$  families were grown in 2009 and identified with the numbers 095113-1 - 095113-6. From the family 095113-5, four individual panicles with partial resistance to crown rust were selected. Partial resistance was characterized by abundant chlorosis and necrosis around small pustules on the leaf laminae, and early telia formation on green leaf tissue of the plants. Similar symptoms have been identified in the cultivar URS 21 and other oat genotypes that presented partial resistance to crown rust (Graichen et al. 2011, Zambonato et al. 2012), and more recently, in the cultivar URS Brava (Federizzi et al. 2015). The resistance mechanism in the oat-crown rust system is not yet fully understood, even though reactive oxygen species seem not to be important in this pathosystem. It seems that in the partial resistance mechanism, observed in URS 21, the death of the fungus occurs first than the death of the cells, differing from the hypersensitive response, in which the cell is killed first (Graichen et al. 2011). Another particularity observed in URS 21 is that the production of phenolic compounds was more pronounced than in a cultivar that presented hypersensitive response (Figueiró et al. 2015).

During the growing season of 2010, the four  $F_{5,6}$  lines were sown under the identification numbers 106088-1 - 106088-4. In that year, the line which gave origin to the cultivar 'URS Altiva' presented high phenotypic uniformity (no visual segregation) and was harvested in bulk, threshed, and coded as 'UFRGS 106088-1'. The new line was first tested in a preliminary trial (2011) and then evaluated during three consecutive years in a net of cooperative trials, including the Regional Trial (2012), the National Trial of first (2013) and second-year (2014). In the cooperative trials, the line 'UFRGS 106088-1' was tested in 30 experiments, carried out in from 9 to 11 locations each year, distributed in the states of Paraná, Rio Grande do Sul, and São Paulo. In all trials, UFRGS 106088-1 was compared with three check cultivars.

Taking together the results obtained in the preliminary trial and in the three years of cooperative tests, the line UFRGS 106088-1 reached satisfactory agronomic performance (data presented below) to be released as a new cultivar. In all trials, the new line achieved grain yield close to or greater than 5% of the best check, which is the main standard established by the Brazilian Oat Research Committee (Comissão Brasileira de Pesquisa de Aveia – CBPA), in order to approve the release of a new oat cultivar using their cooperative trials. The new oat cultivar was released in 2015 and was denominated URS Altiva. The name 'Altiva' (proud, noble) was selected for this cultivar to highlight its robustness, which results in high grain yield potential, grain quality and resistance to crown rust and lodging, when compared with other oat cultivars currently available in Brazil.

### **AGRONOMIC PERFORMANCE**

Approximately 400 g of  $F_7$ -seeds of the oat line UFRGS 106088-1 were harvested in 2010 and used in the preliminary trial, which was carried out at the UFRGS Agronomy Experimental Station in 2011. The new line was compared with the check cultivars URS 21, Barbarasul, and URS Taura for the agronomic traits grain yield, test weight, number of days from emergence to heading, plant height and lodging. Among the check cultivars, URS Taura had the highest mean grain yield of 4504 kg ha<sup>-1</sup>, and the line UFRGS 106088-1 had mean grain yield of 5277 kg ha<sup>-1</sup>, corresponding to 117.2% of the best check. For test weight, an important measure of physical grain quality, the line UFRGS 106088-1 showed weight of 62.8 kg hL<sup>-1</sup>, which was higher than 56.2 kg hL<sup>-1</sup> presented by the best check URS 21. The line UFRGS 106088-1 presented 82 days from the emergence to heading, which was inferior to that observed for the three check cultivars. Considering plant height, the new line was taller, reaching mean of 125 cm, compared with 119, 121 and 109 cm observed for the check cultivars URS 21, Barbarasul and URS Taura, respectively. However, the greatest height did not result in increased plant lodging in the new line, which presented lodging of 40%, while the check cultivars URS 21 and Barbarasul presented 50 and 80%, respectively, and the cultivar URS Taura did not present lodging in this trial.

During the cooperative tests, the oat line UFRGS 106088-1 was evaluated in 11 locations across the states of Rio Grande do Sul (Augusto Pestana, Eldorado do Sul, Passo Fundo and Pelotas), Paraná (Guarapuava, Londrina, Mauá da Serra, Pato Branco, Ponta Grossa and Santa Tereza do Oeste), and São Paulo (Capão Bonito). These trials were carried out under the coordination of the Brazilian Oat Research Committee. Table 1 shows the results for grain yield, test weight, thousand kernel weight, plant height, and lodging obtained for the line UFRGS 106088-1 and the check cultivars, evaluated in the Regional and National Trials of Oat Lines.

In the Regional Trial carried out in 2012, the line UFRGS 106088-1 was compared with the check cultivars URS 21, Barbarasul, and URS Taura. These check cultivars were among the best oat cultivars available in Brazil. The cultivar URS 21 presented the highest agronomic performance for grain yield among the check cultivars, i.e., mean grain yield of 2821 kg ha<sup>-1</sup>, whereas the line UFRGS 106088-1 presented mean grain yield of 3082 kg ha<sup>-1</sup>, corresponding to 109.3% of the best check. When the test weight was evaluated, the cultivar URS 21 was the best check, showing mean test weight of 45.2 kg hL<sup>-1</sup>; on the other hand, the line UFRGS 106088-1 had 51.8 kg hL<sup>-1</sup>, corresponding to 114.5% of the best check. For the trait thousand kernel weight, the cultivar URS Taura was the best check with mean thousand kernel weight of 28.6 g, whereas the line UFRGS 106088-1 had mean thousand kernel weight of 34.9 g, corresponding to 122.1% of the best check. For the traits plant height and lodging, the line UFRGS 106088-1 was taller than all the check cultivars, and exhibited a higher level of lodging resistance when compared with the cultivars URS 21 and Barbarasul. In the Regional Trial of 2012, results for grain yield, test weight, thousand kernel weight, plant height, and lodging were available in 11, 11, 9, 10 and 7 locations, respectively (Table 1).

In the first year of the National Trial of Oat Lines, carried out in 2013, the line UFRGS 106088-1 was compared with the check cultivars URS 21, Barbarasul, and URS Taura. Results demonstrated that the cultivar URS 21 was the best check

for grain yield, test weight, and thousand kernel weight, with mean of 3195 kg ha<sup>-1</sup>, 48.0 kg hL<sup>-1</sup>, and 27.7 g, respectively. The experimental line UFRGS 106088-1 presented mean grain yield of 3570 kg ha<sup>-1</sup>, mean test weight of 53.4 kg hL<sup>-1</sup>, and mean thousand kernel weight of 33.4 g, equivalent to 111.8%, 111.2%, and 120.6% of the best check, respectively. Considering the traits plant height and lodging, the line UFRGS 106088-1 was taller than all the check cultivars, but had the highest level of lodging resistance, even when compared with the check cultivar URS Taura. In 2013, data for grain yield, test weight, thousand kernel weight, plant height, and lodging were available in 10, 10, 7, 8 and 5 locations, respectively (Table 1).

In the National Trial of Oat Lines of second-year, carried out in 2014, the line UFRGS 106088-1 was compared with the check cultivars URS 21, Barbarasul, and URS Corona. The cultivar URS Corona was the best check for grain yield and thousand kernel weight, showing mean of 3488 kg ha<sup>-1</sup> and 31.2 g, respectively. However, the cultivar URS 21 was the

**Table 1.** Grain yield, test weight, thousand kernel weight, plant height and lodging of the oat line UFRGS 106088-1 and the check cultivars evaluated in the Regional Trial of Oat Lines (2012), National Trial of Oat Lines of first-year (2013), and National Trial of Oat Lines of second-year (2014)

Cultivar	Grain yield (kg ha <sup>-1</sup> )				
	2012	2013	2014	BC annual <sup>†</sup>	BC <sub>URS 21</sub> <sup>‡</sup>
URS 21 (C)*	2821	3195	3282	98.0	100
Barbarasul (C)	2650	2589	3093	87.9	89.6
URS Taura (C)	2635	2191	-	81.0	80.2
URS Corona (C)	-	-	3488	100	106.3
UFRGS 106088-1	3082 (109.3) <sup>§</sup>	3570 (111.8)	3656 (104.8)	108.6	110.9
Number of locations	11	10	8	29	29
Cultivar	Test weight (kg hL <sup>-1</sup> )				
	2012	2013	2014	BC annual <sup>†</sup>	BC <sub>URS 21</sub> <sup>‡</sup>
URS 21 (C)	45.2	48.0	46.8	100	100
Barbarasul (C)	42.6	43.2	44.2	92.9	92.8
URS Taura (C)	44.2	43.0	-	93.6	93.5
URS Corona (C)	-	-	46.3	98.8	98.8
UFRGS 106088-1	51.8 (114.5)	53.4 (111.2)	53.2 (113.6)	113.1	113.1
Number of locations	11	10	9	30	30
Cultivar	Thousand kernel weight (g)				
	2012	2013	2014	BC annual <sup>†</sup>	BC <sub>URS 21</sub> <sup>‡</sup>
URS 21 (C)	28.2	27.7	27.8	95.9	100
Barbarasul (C)	26.5	24.6	26.2	88.4	92.3
URS Taura (C)	28.6	26.0	-	96.9	97.6
URS Corona (C)	-	-	31.2	100	112.4
UFRGS 106088-1	34.9 (122.1)	33.4 (120.6)	33.7 (108.0)	116.9	121.9
Number of locations	9	7	8	24	24
Cultivar	Plant height (cm)				
	2012	2013	2014	BC annual <sup>†</sup>	BC <sub>URS 21</sub> <sup>‡</sup>
URS 21 (C)	107.4	115.3	119.1	115.7	100
Barbarasul (C)	103.7	108.9	108.6	108.9	94.0
URS Taura (C)	93.6	94.0	-	100	84.2
URS Corona (C)	-	-	111.0	102.2	93.2
UFRGS 106088-1	112.4 (120.1)	120.9 (128.5)	119.6 (110.1)	119.6	103.2
Number of locations	10	8	8	26	26
Cultivar	Lodging (%)				
	2012	2013	2014	BC annual <sup>†</sup>	BC <sub>URS 21</sub> <sup>‡</sup>
URS 21 (C)	50.9	44.5	56.2	135.7	100
Barbarasul (C)	47.6	35.8	48.8	118.8	87.2
URS Taura (C)	30.5	35.5	-	100	69.3
URS Corona (C)	-	-	59.3	121.3	105.4
UFRGS 106088-1	35.4 (116.1)	29.8 (83.8)	20.5 (42.0)	80.5	56.5
Number of locations	7	5	6	18	18

\*Check cultivar.

<sup>†</sup>Mean performance relative to the best check cultivar, within each year of test, as a percentage.

<sup>‡</sup>Mean performance relative to the check cultivar URS 21, as a percentage.

<sup>§</sup>Values shown in brackets for the line UFRGS 106088-1 demonstrate its performance when compared with the best check within the year of evaluation, in percentage.

best check for test weight, with mean of 46.8 kg hL<sup>-1</sup>. The line UFRGS 106088-1 presented mean grain yield of 3656 kg ha<sup>-1</sup>, mean test weight of 53.2 kg hL<sup>-1</sup>, and mean thousand kernel weight of 33.7 g, corresponding to 104.8, 113.6, and 108.0% of the best check for each agronomic trait, respectively. For plant height and lodging, the line UFRGS 106088-1 was taller and more resistant to lodging than all the check cultivars. In 2014, data for grain yield, test weight, thousand kernel weight, plant height, and lodging were recorded in 8, 9, 8, 8 and 6 locations, respectively (Table 1).

Over the three-year test for grain yield, the line UFRGS 106088-1 was evaluated in 29 experiments, and presented mean grain yield of 3436 kg ha<sup>-1</sup>, corresponding to 108.6% of the best check cultivar within each year. Additionally, the line UFRGS 106088-1 presented grain yield performance equal to 110.9% of that exhibited by the check cultivar URS 21 over time (Table 1). These results clearly indicate the high adaptability and stability of the line UFRGS 106088-1 for grain yield over years and locations of evaluation.

Table 2 shows the number of days from emergence to flowering, days from flowering to maturation, and days from emergence to maturation, reflecting the cycle of the line UFRGS 106088-1 during the three-year test. Considering the number of days from emergence to flowering, the line UFRGS 106088-1 showed mean vegetative cycle of 71.1, 78.5, and 72.2 days in the years of evaluation 2012, 2013, and 2014, respectively. These results demonstrate the earliness of line UFRGS 106088-1, when compared with the check cultivars in the three years of evaluation. However, the line UFRGS 106088-1 had opposite performance for the number of days from flowering to maturation, showing mean of 43.2, 42.9, and 43.1 days, corresponding to 111.3, 114.4, and 107.6% of the earlier check cultivar Barbarasul in 2012 (38.8 days), URS Taura in 2013 (37.5 days), and URS Corona in 2014 (43.1 days), respectively. When the full cycle was measured by the number of days from emergence to maturation, small differences were observed between UFRGS 106088-1 and the check cultivars (Table 2). The longer period from flowering to maturation may be associated with the high grain yield obtained for the line UFRGS 106088-1, as it would allow the plants to accumulate more photoassimilates and translocate them to the grains.

**Table 2.** Days from emergence to flowering, days from flowering to maturation and days from emergence to maturation of the oat line UFRGS 106088-1 and the check cultivars evaluated in the Regional Trial of Oat Lines (2012), National Trial of Oat Lines of first-year (2013), and National Trial of Oat Lines of second-year (2014)

Cultivar	Days from emergence to flowering				
	2012	2013	2014	BC annual <sup>†</sup>	BC <sub>URS 21</sub> <sup>‡</sup>
URS 21 (C)*	77.3	81.8	76.2	102.0	100
Barbarasul (C)	77.7	85.9	79.2	105.2	103.2
URS Taura (C)	72.9	82.3	-	100.3	97.6
URS Corona (C)	-	-	76.6	100.6	100.6
UFRGS 106088-1	71.1 (97.4) <sup>§</sup>	78.5 (96.1)	72.2 (94.8)	96.1	94.3
Number of locations	10	9	8	27	27
Days from flowering to maturation					
URS 21 (C)	39.3	40.1	44.0	103.0	100
Barbarasul (C)	38.8	39.5	43.7	101.8	98.9
URS Taura (C)	40.0	37.5	-	101.0	97.6
URS Corona (C)	-	-	43.1	100	98.1
UFRGS 106088-1	43.2 (111.3)	42.9 (114.4)	46.4 (107.6)	110.7	107.5
Number of locations	7	8	7	22	22
Days from emergence to maturation					
URS 21 (C)	116.8	121.2	119.1	101.4	100
Barbarasul (C)	117.4	125.4	121.6	103.4	102.0
URS Taura (C)	114.1	119.6	-	100	98.2
URS Corona (C)	-	-	118.7	100	99.6
UFRGS 106088-1	115.3 (101.0)	120.9 (101.1)	117.6 (99.1)	100.4	99.0
Number of locations	7	8	7	22	22

\*Check cultivar.

<sup>†</sup>Mean performance relative to the best check cultivar, within each year of test, in percentage.

<sup>‡</sup>Mean performance relative to the check cultivar URS 21, in percentage.

<sup>§</sup>Values shown in brackets for the line UFRGS 106088-1 demonstrate its performance when compared with the best check within the year of evaluation, in percentage.

**Table 3.** Crown rust severity, stem rust severity and leaf spot severity of the oat line UFRGS 106088-1 and the check cultivars evaluated in the Regional Trial of Oat Lines (2012), National Trial of Oat Lines of first-year (2013), and National Trial of Oat Lines of second-year (2014)

Cultivar	Crown rust severity (%)				
	2012	2013	2014	BC annual <sup>†</sup>	BC <sub>URS 21</sub> <sup>‡</sup>
URS 21 (C)*	25.1	24.5	21.2	158.4	100
Barbarasul (C)	32.9	30.5	27.6	204.8	128.7
URS Taura (C)	31.9	36.1	-	137.2	137.1
URS Corona (C)	-	-	7.7	100	36.3
UFRGS 106088-1	6.6 (26.1) <sup>§</sup>	8.5 (34.9)	3.6 (46.8)	35.9	26.4
Number of locations	10	7	7	24	24
Cultivar	Stem rust severity (%)				
	2012	2013	2014	BC annual <sup>†</sup>	BC <sub>URS 21</sub> <sup>‡</sup>
URS 21 (C)	3.9	3.6	6.2	107.8	100
Barbarasul (C)	5.2	6.0	7.0	146.3	132.5
URS Taura (C)	3.6	10.1	-	188.8	181.7
URS Corona (C)	-	-	5.3	100	86.5
UFRGS 106088-1	3.0 (82.5)	3.4 (93.1)	4.4 (82.8)	86.1	78.7
Number of locations	9	4	3	16	16
Cultivar	Leaf spot severity (%)				
	2012	2013	2014	BC annual <sup>†</sup>	BC <sub>URS 21</sub> <sup>‡</sup>
URS 21 (C)	17.7	28.8	28.9	106.6	100
Barbarasul (C)	18.6	31.6	29.8	113.0	106.2
URS Taura (C)	22.5	26.8	-	113.6	106.1
URS Corona (C)	-	-	25.7	100	89.0
UFRGS 106088-1	12.8 (72.4)	23.9 (89.3)	15.0 (58.5)	73.4	68.7
Number of locations	8	7	8	23	23

\*Check cultivar.

<sup>†</sup>Mean performance relative to the best check cultivar, within each year of test, in percentage.

<sup>‡</sup>Mean performance relative to the check cultivar URS 21, in percentage.

<sup>§</sup>Values shown in brackets for the line UFRGS 106088-1 demonstrate its performance when compared with the best check within the year of evaluation, in percentage.

The high grain yield observed for the line UFRGS 106088-1 is also associated with its genetic resistance against the main oat diseases. Table 3 shows the results of crown rust severity, stem rust severity, and leaf spot severity. The line UFRGS 106088-1 presented very low severities for crown rust, during the three years of cooperative tests. Mean crown rust severity for the line UFRGS 106088-1 was 6.6, 8.5, and 3.6% in 2012, 2013, and 2014, respectively. These results corresponded to 26.1, 34.9, and 46.8% of the best check cultivar in each year of evaluation. URS 21 was the best check cultivar for crown rust in 2012 and 2013, whereas URS Corona was the best check cultivar in 2014. The line UFRGS 106088-1 also presented desirable levels of resistance against stem rust caused by the fungus *Puccinia graminis* f. sp. *avenae*. In the three-year test, the line had mean stem rust severity of 3.0, 3.4, and 4.4%, corresponding to 82.5, 93.1, and 82.8% of the best check URS Taura, in 2012, URS 21, in 2013, and URS Corona, in 2014, respectively. The severity of leaf spot, mainly caused by the fungus *Pyrenophora chaetomioides* Speg., was relatively low in the line UFRGS 106088-1, when compared with the check cultivars. In the three-year test, the line showed mean leaf spot severity of 12.8, 23.9, and 15.0%, corresponding to 72.4, 89.3, and 58.5 of the best check in each year. The cultivar URS 21 was the best check in the Regional Trial, carried out in 2012; the cultivar URS Taura was the best check in the National Trial of first-year, carried out in 2013; and the cultivar URS Corona was the best check in the National Trial of second-year, carried out in 2014 (Table 3).

The cultivar URS Altiva, after its release, was registered in the National Registry of Cultivars ('Registro Nacional de Cultivares'), of the Ministry of Agriculture, Livestock and Supply ('Ministério da Agricultura, Pecuária e Abastecimento - MAPA'), under the number 34272. The new cultivar was protected by the National Service for Cultivar Protection ('Serviço Nacional de Proteção de Cultivares'), under the certificate number 20160023. The cultivation of URS Altiva is recommended for the states of Rio Grande do Sul, Santa Catarina, Paraná, and São Paulo. A volume of approximately 30 tons of breeder seeds harvested in 2015 will be used for the production of foundation seeds.

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