ITEMS FROM BRAZIL

BRAZILIAN AGRICULTURAL RESEARCH CORPORATION — EMBRAPA
Rodovia BR 285, km 294, Caixa Postal 451, Passo Fundo, RS, Brazil.

Wheat in Brazil – 2012 crop year.

Eduardo Caierão.

In the 2012 crop year, Brazilian wheat production was about 4 x 10^6 tons (Conab 2013), which is enough to supply 40% of the domestic demand (Table 1). The deficit in production makes Brazil the largest wheat importer. The southern region, comprised of the states of Rio Grande do Sul, Santa Catarina, and Paraná, accounts for 94.6% of the national production. Nonetheless, due to the characteristics of the cultivation system, average grain yield in this region is not the highest in the country.

Table 1. Area of cultivation, total production, and grain yield of wheat in Brazil in 2012 (Source: CONAB 2013).

Region	Area (ha x 1,000)	Production (t x 1,000)	Grain yield (kg/ha)
North	—	—	—
Northeast	—	—	—
Central–West	24.8	68.2	2,750.0
Southeast	53.5	162.4	3,036.0
South	1,817.1	4,069.8	2,240.0
Brazil	**1,895.4**	**4,300.4**	**2,269.0**

In 2012, the wheat area cultivated was lower than that in 2011 (1,895.4 against 2,166.2). The total production and average grain yield/ha achieved in 2012 were 25% and 15% smaller than 2011, respectively. High rainfall and frost during grain filling were the main factors that justify these data.

Reference.

CONAB. 2012. Companhia Nacional de Abastecimento. Central de Informações Agropecuárias/Grãos/Trigo. Disponível em: http://www.conab.gov.br/conabweb/index.php?PAG=131

Wheat seed market in Brazil – 2009 to 2012.

Eduardo Caierão.

Few companies hold the wheat seed market in Brazil, characterized primarily by private capital. The percent participation of each company in the seed market between 2009 and 2012 in Brazil (Table 2), versus that in the main cereal producing states of Rio Grande do Sul (Table 3, p. 6) and Paraná (Table 5, p. 6) are given. In terms of Brazil, the percent of the market covered by private companies was 71.20%, 74.78%, 75.70%, and 85.09%, respectively, from 2009 to 2012 (Table 2), indicating increased participation of private

Table 2. The market for wheat in Brazil between 2009 and 2012, Passo Fundo, Brazil, 2013 (Source: Kleffmann 2013, bold values indicate the highest percent in each year).

Company	Type	2009	2010	2011	2012
Biotrigo	Private	0.00%	0.00%	0.12%	6.75%
Coodetec	Private	**25.79%**	22.08%	19.21%	18.38%
Embrapa	Public	25.27%	23.62%	22.11%	13.42%
CCGL TEC	Private	21.17%	12.36%	9.79%	6.72%
OR Sementes	Private	24.23%	**40.34%**	**46.58%**	**53.24%**
Outros	Public	3.53%	1.60%	2.18%	1.49%
Total	Private	71.20%	74.88%	75.70%	85.09%
	Public	28.80%	25.22%	24.30%	14.91%

companies in the seed market. Coodetec (2009) and OR Sementes (2010, 2011, and 2012) were the market leaders. Analyzing the information by state, there are some differences. In Rio Grande do Sul, for example, the participation of private companies in the seed market is even higher, over 90% in 2011 and 2012. However, the leadership still prevailed OR Sementes. In Paraná, public enterprises occupy an area more significant than in Rio Grande do Sul, reaching 37% in 2011, primarily due to the contribution of Embrapa. In this state, Coodetec led the market in 2009, 2010, and 2012. Embrapa had greater participation in 2011. The use of certified seed, saved seed, or breeder seed for each region (Brazil, and the states of Rio Grande do Sul and Paraná) are given (Tables 5, 6, and 7). The highest use of certified seed can be found in Paraná, ranging from 79.45% to 89.67%. The usage profile in Rio Grande do Sul is much lower, reaching a level close to 50% in 2012.

Table 3. The market for wheat in the state of Rio Grande do Sul between 2009 and 2012. Passo Fundo, Brazil, 2013 (Source: Kleffmann 2013. Bold values indicate the highest percent in each year).

Company	Type	2009	2010	2011	2012
Biotrigo	Private	0.00%	0.00%	0.00%	9.18%
Coodetec	Private	1.28%	1.95%	3.02%	0.53%
Embrapa	Public	14.08%	18.26%	8.40%	7.46%
CCGL TEC	Private	**54.39%**	30.66%	21.35%	12.11%
OR Sementes	Private	29.70%	**49.13%**	**67.13%**	**69.74%**
Outros	Public	0.55%	0.00%	0.10%	0.97%
Total	Private	85.37%	81.74%	91.50%	91.56%
	Public	14.63%	18.26%	8.50%	8.44%

Table 4. The market for wheat in the state of Paraná between 2009 and 2012. Passo Fundo, Brazil, 2013 (Source: Kleffmann 2013. Bold values indicate the highest percent in each year).

Company	Type	2009	2010	2011	2012
Biotrigo	Private	0.00%	0.00%	0.02%	3.27%
Coodetec	Private	**45.52%**	**37.29%**	34.30%	**40.94%**
Embrapa	Public	31.76%	26.32%	**34.41%**	20.44%
CCGL TEC	Private	0.21%	0.36%	0.64%	0.63%
OR Sementes	Private	18.54%	34.38%	27.65%	33.27%
Outros	Public	3.98%	1.65%	2.98%	1.45%
Total	Private	64.27%	72.03%	62.61%	78.11%
	Public	35.73%	27.97%	37.39%	21.89%

Table 5. Percent of certified and saved seed in the wheat market in Brazil. Passo Fundo, Brazil, 2013 (Source: Kleffmann 2013. Bold values indicate the highest percent in each year).

Type of seed	2009	2010	2011	2012
Breeder Seed	1.41%	0.06%	2.14%	1.86%
Certified	**79.18%**	**78.82%**	**76.42%**	**64.47%**
Saved	19.41%	21.11%	21.44%	33.67%

Table 6. Percent of certified and saved seed in the wheat market in the state of Rio Grande do Sul, Brazil. Passo Fundo, Brazil, 2013 (Source: Kleffmann 2013. Bold values indicate the highest percent in each year).

Type of seed	2009	2010	2011	2012
Breeder Seed	0.92%	0.00%	4.49%	2.61%
Certified	**69.25%**	**63.49%**	**65.14%**	**51.59%**
Saved	19.41%	21.11%	21.44%	33.67%

Table 7. Percent of certified and saved seed in the wheat market in the state of Paraná, Brazil. Passo Fundo, Brazil, 2013 (Source: Kleffmann 2013. Bold values indicate the highest percent in each year).

Type of seed	2009	2010	2011	2012
Breeder Seed	1.32%	0.00%	0.22%	0.81%
Certified	**87.36%**	**89.67%**	**86.33%**	**79.45%**
Saved	11.32%	10.33%	13.45%	19.74%

Reference.

Kleffmann Group. 2013. Wheat seed's market in Brazil - 2009 to 2012. Available at: http://www.kleffmann.com.

Use of Embrapa germ plasm in Brazilian wheat breeding programs.

Eduardo Caierão, Pedro L. Scheeren, Márcio Só e Silva, Ricardo Lima de Castro, and Adeliano Cargnin.

Embrapa has about 25% of wheat seed market in Brazil. The wheat breeding program of Embrapa started in 1974 and, since that time, more than 100 new cultivars have been released. Since 2005, the number of recommended wheat cultivars in Brazil is over 100; only in 2009 was the number was lower (Table 8). The number of cultivars that use Embrapa germ plasm (NCWEG) in this period range according to new releases and retry of materials. The relationship between indicated cultivars and NCWEG was 65.4%, 65.4%, 64.9%, 62.3%, 64.9%, 65.0%, 71.3%, and 71.8%. In 2012, more than 71% of the wheat cultivars recommended to producers had at least one Embrapa's genotype in your genealogy.

Table 8. Wheat cultivars indicated by Brazilian breeding institutions for cultivation, from 2005 to 2012; number of cultivars indicated with Embrapa germ plasm (NCWEG) in the genealogy and percent of use (% USE). Passo Fundo, RS, Brazil, 2013.

	2005	2006	2007	2008	2009	2010	2011	2012	Mean
Indicated cultivars	104	104	111	106	94	100	101	110	104
NCWEG	68	68	72	66	61	65	72	79	69
% UGE	65.4	65.4	64.9	62.3	64.9	65.0	71.3	71.8	66.4

Pyramiding genes for tolerance to preharvest wheat sprouting by backcrossing.

Adeliano Cargnin, Flávio Martins Santana, Eduardo Caierão, Ricardo Lima de Castro, Pedro Luiz Scheeren, Marcos Fabris, and Marcos Kovaleski.

A study of gene pyramiding for tolerance to preharvest sprouting into new wheat lines began in July 2011, at Embrapa Trigo, through the backcross method. The study obtained and evaluated the first generation backcross (BC_1) originated from a cross between contrasting wheat germ plasm for tolerance to preharvest sprouting. The study was conducted at Embrapa Trigo in Passo Fundo, RS. The recurrent parental was the cultivar BRS Pardela. As parental donors, we used the cultivars Lagoa Vermelha and Syrimex. Crosses were made between the recurrent and the donors, and then the F_1 was backcrossed with the recurrent parent to produce the BC_1. Seeds of the BC_1 were evaluated for tolerance to preharvest sprouting by a germination test. For this test, the seeds were sown on RC1 germitest paper moistened and placed in a Mangelsdorf germination chamber at 20°C ± 2°C. On the third and fourth day after sowing (72 and 96 hours), counts were performed and germinated seeds removed. The remaining seeds were sown in plastic pots under greenhouse conditions in order to give rise the next generation of backcrossing. The methodology applied in this study was effective for discriminating BC_1 populations with regard to the level of tolerance for preharvest sprouting. By this method, 20% to 40% of the BC_1 seeds were eliminated (Fig. 1). Removing a greater number of seeds enhances the probability of making the next backcross with plants with good tolerance to preharvest sprouting. Thus, the cross 'Pardela BRS/Syrimex' was more efficient in selection; more than 40% of the seeds were eliminated. On the other hand, the cross 'BRS Pardela/Lagoa Vermelha' proved to have promising cross-tolerance to preharvest sprouting, because approximately 80% of the seeds did not germinate, even after 96 hours of germination treatment.

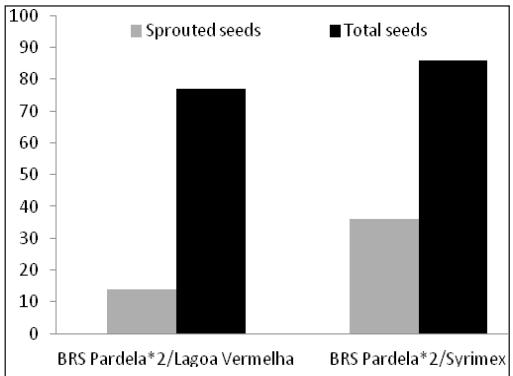

Fig. 1. Sprouted seeds and total seeds in two backcrossing population (BC_1) of wheat (Passo Fundo, Brazil, 2012).

Resistance gene pyramiding for Fusarium head blight (FHB) in wheat by backcrossing.

Adeliano Cargnin, Flávio Martins Santana, Eduardo Caierão, Ricardo Lima de Castro, Pedro Luiz Scheeren, Marcos Fabris, and Marcos Kovaleski.

A project pyramiding resistance genes for FHB on new wheat lines was initiated in July 2011 at Embrapa Trigo, using a backcrossing method. The objective was evaluate plants from the first generation of backcrossing (BC_1) that came from crossing germ plasm resistant vs. susceptible to FHB. This research was done at Embrapa Trigo, Passo Fundo, RS, Brazil. The recurrent parent was the commercial cultivar BRS Guabiju. The donor parental was the cultivar Sumai 3. Crosses between the recurrent and donor parents were made during the winter, 2011. The F_1 offspring was backcrossed with the recurrent parent in the summer of 2011, producing the first backcross generation (BC_1). Plants from the BC_1 were evaluated for reaction to FHB. Seeds of BC_1 were sown in plastic plots in the green-house. At the flowering time (Feekes and Large scale 10.5.1), a spore suspension of the *Gibberella zeae* isolate 6047 was sprayed over the spikes at a concentration of 100.000 spores/mL applied at 25°C ± 2°C and 80% humidity. Ten days after the inoculation. the plants were evaluated for incidence and severity of FHB. The methodology applied for this research was efficient fpr screening the BC_1 population for FHB resistance level. The genotypes were separated into six classes of FHB severity, from 0 to 100% (Fig. 2). We evaluated 165 spikes, of which 92 showed no FHB symptoms. Hence, the frequency of spikes resistant to FHB (0% of severity) in the BC_1 generation was 56%. The cross 'BRS Guabiju/Sumai 3' is a good source of genetic variability for resistance to FHB.

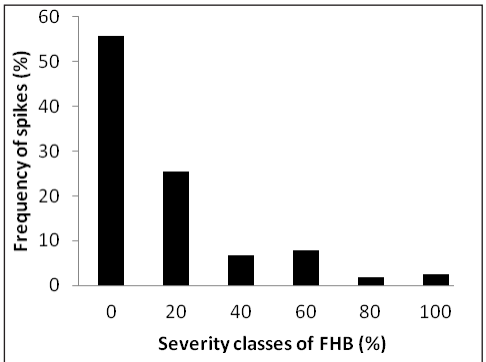

Fig. 2. Frequency of severity of Fusarium head blight in wheat spikes in a backcross (BC_1) population inoculated under greenhouse conditions (Passo Fundo, Brazil, 2012).

Response of wheat cultivars to inoculant use in southern Brazil.

Ricardo Lima de Castro, José Pereira da Silva Júnior, Eduardo Caierão, Adeliano Cargnin, and Luciano Consoli.

Inoculation of wheat seeds with *Azospirillum brasiliense* bacteria has resulted in an increase in wheat grain yield in southern Brazil. However, the effect of inoculation with this facultative endophytic bacterium, capable of fixing nitrogen from the atmosphere and providing part of the associated N required by the plant, has been dependent on the wheat cultivar. To identify the cultivars most responsive to the association with *A. brasiliense*, 32 wheat cultivars of southern Brazil were evaluated with and without seed inoculation. The experiment was carried out at Embrapa Wheat (lat 28°15'S, long 52°24'W, alt 684 masl), in Passo Fundo, state of the Rio Grande do Sul, Brazil, in a randomized block design with three replications. Each plot consisted of three 3-m rows with 0.17 m spacing between rows (1.8 m^2). The variables studied were aerial part dry mass, grain yield, harvest index, plant height, and number of spikes per area. Data were subjected to analysis of variance and the treatments with and without inoculation were compared by the t test ($P < 0.05$) for each wheat cultivar. Inoculation of wheat seeds with *A. brasiliense* bacteria resulted in an increase of grain yield in wheat cultivars Turquesa (+1,535 kg/ha or +43%), TBIO Itaipu (+971 kg/ha or +35%), CD 123 (+800 kg/ha or +40%), TBIO Alvorada (+775 kg/ha or +24%), CD 1550 (+675 kg/ha or +22%), BRS 331 (+607 kg/ha or +22%), BRS 374 (+570 kg/ha or +16%), Fundacep Raízes (+544 kg/ha or +20%), TBIO Seleto (+458 kg/ha or +14%), TEC Frontale (+367 kg/ha or +10%), Marfim (+361 kg/ha or +12%), Ametista (+356 kg/ha or +12%), CD 114 (+296 kg/ha or +10%), JF 90 (+272 kg/ha or +9%), TBIO Mestre (+267 kg/ha or +7%), TBIO Pioneiro (+172 kg/ha or +4%), and CD 122 (+84 kg/ha or +3%). Only for cultivars CD 123 and TBIO Alvorada was the difference in grain yield mean with and without inoculation statistically significant by the t test ($P < 0.05$). The most responsive cultivars to inoculation with *A. brasiliense* will be used in wheat breeding programs in southern Brazil.