ever, the average grain yield obtained in this mesoregion was the second highest of the state, 3,309 kg/ha (44 kg/ha above the state average) (Table 1). The RS Northeast mesoregion harvested 42,885 ha of wheat (5.5% of the cropped area in the state), produced 155,394 tons of wheat grain (6.1% of the state production), and had the highest average grain yield in the state (3,624 kg/ha, 359 kg/ha above the state average) (Table 1). The wheat crop in Rio Grande do Sul in 2016 had favorable weather conditions, with low temperatures in the winter and no late frost in the spring. Consequently, the average wheat grain yield in 2016 was the highest in the history of the Rio Grande do Sul state. Comparing the wheat crop data with the results of the State Test of Wheat Cultivars in the state of Rio Grande do Sul (STWC-RS) in 2016, we observed that the average wheat grain yield of commercial crops was 2,234 kg/ha below that of the average of STWC-RS (5,499 kg/ha).

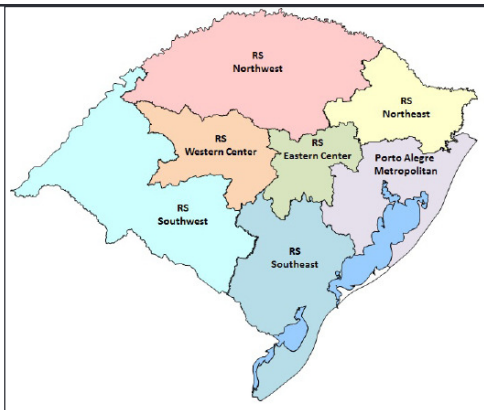

Fig. 1. Mesoregions in the state of Rio Grande do Sul, Brazil.

Reference.

IBGE. 2018. Sistema IBGE de Recuperação Automática - SIDRA. Available at: <https://sidra.ibge.gov.br/tabela/5457>. Acessed 23 March, 2018. Note: Aggregated database of studies and research conducted by IBGE.

Table 1. Area harvested, production, and average of grain yield of wheat in each of the mesoregions (see Fig. 1) of the state of Rio Grande do Sul, Brazil, in 2016 (Source: IBGE. 2018).

Mesoregion	Area harvested		Production		Grain yield (kg/ha)
	ha	%	tons	%	
RS Northwest	617,066	79.3	2,041,670	80.3	3,309
RS Northeast	42,885	5.5	155,394	6.1	3,624
RS Western Center	51,687	6.6	167,953	6.6	3,249
RS Eastern Center	11,325	1.5	27,943	1.1	2,467
Porto Alegre Metropolitan	2,100	0.3	5,160	0.2	2,457
RS Southwest	46,503	6.0	127,599	5.0	2,744
RS Southeast	6,920	0.9	16,170	0.6	2,337
Rio Grande do Sul State	778,486	100.0	2,541,889	100.0	3,265

A history of wheat cultivars released by Embrapa in 45 years of research.

Eduardo Caierão, Ricardo Lima de Castro, Márcio Só e Silva, and Pedro Luiz Scheeren.

Genetic breeding of wheat in Brazil truly began in 1919, when the Ministério da Agricultura, Pecuária e Abastecimento (Ministry of Agriculture, Livestock, and Food), created experimental stations in Alfredo Chaves, RS (now Veranópolis, RS) and Ponta Grossa, PR. The station in Veranópolis, later incorporated in the Department of Agriculture of the State of Rio Grande do Sul (now the Fundação Estadual de Pesquisa Agropecuária – Fepagro (State Crop and Livestock Research Foundation)), was the site where genetic breeding first began in Brazil. These activities were led by the researcher Carlos Gaier. The first strategies were selections of wheat genotypes within local (colonial) cultivars and, soon after, in 1926, the creation of the first hybrids. Crosses between the cultivars Polyssú (Beckman 1954) and Alfredo Chaves resulted in important cultivars at the beginning of the century in Brazil (Sousa 2004). Almost simultaneously, in 1937, the Instituto Agronômico de Campinas (IAC, Campinas Agronomical Institute) also carried out its first crosses with wheat. These two institutions, allied with the other Organizações Estaduais de Pesquisa Agropecuária (OEPAS, or State Crop and Livestock Research Organizations), contributed to the genetic breeding of Brazilian wheat in various aspects, but mainly through developing the genetic base. Some cultivars developed in the first half of the last century are used as sources of resistance to biotic and abiotic stresses in current hybridizations. In this respect, even now, the institutions cited above are either protagonists or partners of other breeders in the continuing work of developing new wheat cultivars in Brazil.

In the 1970s, scientific research in wheat developed significantly with the creation of research centers by agricultural cooperatives in the state of Rio Grande do Sul (CEP/Fecotrigo, currently CCGL TEC) and in the state of Paraná (Ocepar, currently Coodetec), responsible for generating dozens of wheat cultivars of economic importance. Examples of this were the cultivars CEP 24 (in Rio Grande do Sul) and CD 104 (in Paraná). Moreover, in that decade there was the creation of the Instituto Agronômico do Paraná–IAPAR (Agronomical Institute of Parana) and expansion of the work of the IAC. More than 70 wheat cultivars have already been released by IAPAR and IAC, which also shows their importance in the development of wheat in Brazil. In 1974, the Empresa Brasileira de Pesquisa Agropecuária–Embrapa

(Brazilian Crop and Livestock Research Company) was created (Sousa 1998), a milestone in crop and livestock scientific research in the country, which resulted in significant advances in agriculture, particularly in the grain yields of many crops and, especially, of wheat. The creation of private companies for wheat breeding, such as OR Sementes (in 1989), Biotrigo Genética Ltda (in 2008), and DNA Melhoramento Vegetal (also in 2008), among others, came to consolidate the system of genetic research of the cereal crop in Brazil in recent decades.

The Embrapa genetic breeding program for wheat also began in 1974, together with creation of the Centro Nacional de Pesquisa de Trigo (National Wheat Research Center), located in Passo Fundo, RS. Initially, the program was based on germplasm incorporated from the Instituto de Pesquisas e Experimentação Agropecuárias do Sul–IPEAS (Southern Crop and Livestock Research and Experimentation Institute), which later would carry out its own hybridization program (Sousa 2004). The first wheat cultivar from Embrapa, CNT 1, was released in 1975 (Sousa 1998).

Embrapa, as a research institution, is a coordinator of the national project of genetic breeding of the cereal crop in the Embrapa Trigo (CNPT) unit, located in Passo Fundo, RS. However, because the variability in climatic and soil conditions within the regions suitable for growing wheat is quite large, other units contribute to the genetic breeding of wheat to overcome specific problems of the region where they are located, and they operate as branches of the research effort of Embrapa Trigo. Three Embrapa units stand out in this role of collaboration in the national wheat project: the Embrapa Soja–CNPSo (Embrapa Soybean) unit, located in Londrina, PR, responsible for the release of cultivars adapted to the northeast of this state; the Centro de Pesquisa Agropecuária do Cerrado unit – CPAC (Crop and Livestock Research Center of the Cerrado), located in Brasilia, DF, responsible for indication of cultivars of the dryland and irrigated regime for the Brazilian cerrado (tropical savanna); and the Centro de Pesquisa Agropecuária Oeste unit – CPAO (West Crop and Livestock Research Center), located in Dourados, MS, charged with indicating cultivars for that region.

Quite often, Embrapa wheat breeders are asked for information with regard to year of release, cross, pre-commercial name, and region for which the wheat cultivars released were indicated. Among those requesting this information include the technical assistance sector, the academic sector connected with the agricultural areas, and the wheat segment itself connected with the company. Part of this information may be easily accessed, especially through folders distributed at the time of launching the cultivars and in some publications of the Comissão Brasileira de Pesquisa de Trigo e Triticale (Brazilian Wheat and Triticale Research Commission). However, a significant part of this information is not available (or at least is not easily accessed), and no organized document gathers the historical information of release of wheat cultivars of Embrapa in Brazil from the time of its creation. All the wheat genetic breeding institutions, whether public or private, have made their contribution to the agronomic and qualitative development of the cereal crop in Brazil. This study is an historical survey of all the wheat cultivars released by Embrapa, compiling the main information for identification, and their contribution to wheat development in Brazil.

The historical survey of the wheat cultivars indicated for growing in Brazil from 1974 to 2018 was based on guiding bibliographical documents. Publications arising from research meetings of the Comissão Brasileira de Pesquisa de Trigo e Triticale were consulted (Comissão 2004 a, b, and c; 2005 a and b; 2006; 2007; 2008; 2009; 2010; 2011; 2012) and books from different authors connected with the breeding programs (Sousa 1998, 2003, 2004), folders, audio-visual material, and annual research reports. Technical documents filed in other Embrapa units were solicited. Retired Embrapa researchers also were consulted to complement and systematize the information. The following information was gathered together for each cultivar indicated: year of release, commercial name, pre-commercial line name, cross, Embrapa unit responsible for introduction of the cultivar, and situation of the cultivar at the Serviço Nacional de Proteção de Cultivares (National Cultivar Protection Service) (if the cultivar is protected or not).

The wheat cultivars were grouped according to the Embrapa unit in which they were generated and then by the year of release. Divergent information related to the same cultivar was checked in detail for the purpose of consistency of the document. The cultivars protected by the Ministério da Agricultura, Pecuária e Abastecimento (MAPA) were identified by accessing the site http://extranet.agricultura.gov.br/php/snpc.

From 1974 to 2018, Embrapa introduced 120 wheat cultivars for planting (Table 2, p. 8). The largest number of introductions were made by CNPT (81 releases). The CPAC, CNPSo, and CPAO units introduced 16, 14, and 9 cultivars, respectively. The proportion of these releases is explained through two reasons. The first is that the CNPT, being the national leader of the wheat genetic breeding project of Embrapa and, consequently, has the national mandate for development of the crop, with the greatest technical and physical structure available among the units. The second, though not less important, refers to the fact that most of the wheat-growing area in Brazil is located in the states of Rio Grande

Table 2. Number of wheat cultivars released by Embrapa, classified by decade of release and unit responsible for introducing the cultivar. Embrapa: Passo Fundo, RS, Brazil, 2018.

Embrapa Unit	Decade					
	1970–80	1980–90	1990–2000	2000–10	2010–18	Total
Centro Nacional de Pesquisa de Trigo (CNPT)	14	20	17	20	10	81
Centro de Pesquisa Agropecuária do Cerrado (CPAC)	1	5	6	2	2	16
Centro Nacional de Pesquisa de Soja (CNPSo)	—	—	—	9	5	14
Centro de Pesquisa Agropecuária Oeste (CPAO)	—	6	3	—	—	9
Total	15	31	26	31	17	120

do Sul, Santa Catarina, and Paraná. The crops developed by the CNPT are indicated for these states, especially in relation to adaptation and reaction to the main biotic and abiotic stresses.

Using decades since the creation of Embrapa, the 1980s and the first decade of the 21st century were those that exhibited the greatest number of cultivars indicated for planting, regardless of the unit from which they were released (31 releases). In the past eight years (2010–18), 10 new wheat cultivars were released, almost exclusively by the CNPT. All cultivars from CNPT (Tables 3 (p. 9) and 4 (p. 10)), from CPAC (Table 5, p. 11), from CNPSo (Table 6, p. 11), and from CPAO (Table 7, p. 12) are given.

Cultivars from CNPT went through four steps before receiving their commercial name. From 1975 to 1977, they were called 'CNT' (Table 3, p. 9), from 1979 to 1991, 'Trigo BR' (Tables 3 (p. 9) and 4 (p. 10)), and from 1992 to 1996, 'Embrapa' (Table 5, p. 11). With the advent of the Cultivar Protection Law (Lei de Proteção de Cultivares) in 1997, all cultivars were called "BRS" (Table 4). These name changes occurred through the years due to legal and strategic modifications of the company. The first decade of releases by the CNPT was highly influenced by the germplasm coming from the now extinct Instituto Agronômico do Sul (IAS), located in Pelotas, RS, present in almost all the cultivars indicated in this period (Table 3). From 1986 to 2002, the germplasm used for generation of the new cultivars was highly varied and from different origins.

In 2002, Embrapa Trigo established a partnership with the Fundação Pró-Sementes de Apoio à Pesquisa (Pro-Seeds Research Support Foundation), with the goal of adapting to the need for a greater experimental network for determining the Value for Cultivation and Use (VCU) trials of its lines for purposes of protection. The Foundation cited was responsible for bringing about the experimental network of the lines that originated in that unit. In return, the producers connected with the institution were given priority in acquisition of the basic seed of the new cultivars for commercialization. In this period of the partnership, 19 cultivars were indicated for planting (in chronological order): BRS Angico, BRS Figueira, BRS Timbaúva, BRS Buriti, BRS Camboatá, BRS Guabijú, BRS Louro, BRS Umbú, BRS Camboim, BRS Canela, BRS Guatambu, BRS Tarumã, BRS Guamirim, BRS 276, BRS 277, BRS 327, BRS 328, BRS 331, and BRS 374 (Table 4, p. 10). As a marketing strategy, most were given names of trees, and only at the end of the partnership were they designated with numbers in series. The partnership between Embrapa Trigo and the Fundação Pró-Sementes de Apoio à Pesquisa ended in 2006. In spite of that, until 2012, cultivars originating from the partnership were still indicated because the lines had already been included in the Annual Work Plans at the time the contract was terminated.

Of the 81 cultivars released by Embrapa Trigo in the 40 years of research, some became the most planted cultivars in the state of Rio Grande do Sul, especially CNT 10 (1982), CNT 8 (1985–87), Trigo BR 23 (1990–94), Embrapa 16 (1995–98), BRS 49 (2000), BRS 179 (2002–03) (Sousa 2004), and BRS Guamirim (2009). The cultivar BRS 179, for example, was notable for its increased level of grain yield and tolerance to Fusarium head blight, and is used today in hybridizations for FHB resistance. For its part, the cultivar BRS Guamirim established a different plant size parameter at the time of its release. Of low stature and very early cycle, BRS Guamirim exhibited broad adaptation to all the wheat-growing regions of Brazil, with a rapid rise in planted area. The situation for BRS Tarumã is noteworthy (2004, Table 4, p. 10), with a dual-purpose profile, despite not appearing in official seed production statistics. This cultivar exhibits characteristics different from conventional wheat, is adapted to crop-livestock integration, with tolerance to animal trampling, high tillering capacity, and the capacity for creating new shoots when subjected to grazing. In the 10 years after its release, the official seed volume produced was never significant, although it is increasing. However, estimates in Rio Grande do Sul indicate approximately 10% of the area is planted to BRS Tarumã, especially in the dairy cattle regions. One factor that explains the absence in the official statistics is the fact that this cultivar is being used more by small producers, who save seed. In 2012 and 2013, Embrapa Trigo indicated that the cultivars BRS Parrudo and BRS Marcante

Table 3. Wheat cultivars released by Embrapa - Centro Nacional de Pesquisa de Trigo (CNPT) in the 1970s and 1980s, name of the pre-commercial line, and cross. Embrapa: Passo Fundo, RS, Brazil, 2018 (* The mass of the lines PF 79765, PF 79767, PF 79780, PF 79782, and PF 7979 are not phenotypically distinguishable).

Year	Cultivar	Line	Cross
1975	CNT 1	PF 70225	PF 11-1000-62/BH 1146
1975	CNT 2	PEL 14049-68	IAS 16/Norin 26
1975	CNT 3	PF 70194	IAS 20/IAS 46
1976	CNT 4	PEL 13014-65	Lerma 50/3/IAS 31//IAS 20/Reliance
1976	CNT 5	PF 6946	IAS 46/BH 546
1976	CNT 6	PF 69162	IAS 20/IAS 50
1976	CNT 7	PF 70546	IAS 51//IAS 20/ND 81
1976	CNT 8	PEL-SL-1268-69	IAS 20/ND 81
1977	CNT 9	PEL 72016	IAS 46/IAS 49//IAS 46/Tokai 66
1977	CNT 10	PEL 72018	IAS 46/IAS 49//IAS 46/Tokai 66
1979	Trigo BR 1	PF 70402	IAS 20/IAS 50
1979	Trigo BR 2	PF 7158	IAS 50/4/IAS 46/3/Vilela Sol*4//Egypt101/Timstein
1979	Trigo BR 3	PF 72518	IAS 50/4/IAS 46/3/Vilela Sol*4//Egypt101/Timstein
1979	Trigo BR 4	PF 73226	IAS 20*3/Sinvalocho Gama
1980	Trigo BR 5	PF 74354	IAS 59//IAS 52/Gasta
1980	Trigo BR 6	PEL 73538	IAS 20/Toropi
1981	Trigo BR 7	PF 72206	IAS 20/Toropi
1983	Trigo BR 8	PF 75171	IAS 20/Toropi // PF 70100
1985	Trigo BR 13	PF 782027	IAS 51//IAS 20/ND 81, CNT 7 Sel
1985	Trigo BR 14	Multilinha*	IAS 63/Alondra Sib//Gaboto/Lagoa Vermelha
1985	Trigo BR 15	PF 79300	IAS 54*2/Tokai 80//PF 69193
1986	Trigo BR 16-Rio Verde	PF 79678	PF 70402/Alondra Sib//PAT72160/Alondra Sib
1986	Trigo BR 19	PF 79502	CNT 1/CNT 10
1987	Trigo BR 20-Guató	PF 81189	BH 1146*3/Alondra Sib
1987	Trigo BR 21-Nhandeva	PF 79475	Cajeme 71/PF 70553
1987	Trigo BR 22	PF 7942	PF 81130/CNT 10
1987	Trigo BR 23	PF 8215	Corre Caminos/Alondra Sib /3/IAS54-20/Cotiporã//CNT 8
1988	Trigo BR 24	PF 8150	IAS 58*2/Eagle
1988	Trigo BR 25	PF 81230	BH 1146*3/Alondra Sib
1988	Trigo BR 27	PF 80271	RC 7201/BR 2
1988	Trigo BR 28	PF 81330	IAS 55/PF 70553
1988	Trigo BR 32	PF 82345	IAS 60/Indus//IAS62/3/AlondraSib/4/IAS 59
1989	Trigo BR 34	PF 839204	Alvarez 110/2*IAS 54/6/Toropi /4/TZPP/Sonora 64//Napo /3/Ciano/5/PF 6968
1989	Trigo BR 35	PF 83144	IAC 5*2/3/CNT7*3/Londrina//IAC5/Hadden

were characterized by qualitative stability and bread improver profile. Cultivar BRS Parrudo has an innovative plant ideotype, combining lodging resistantce, upright leaves, high vigor in initial development, and excellent resistance to the main biotic stresses of wheat. Cultivar BRS Marcante, for its part, stands out through high grain yield, without impairing flour/gluten strength, a combination difficult to find in wheat breeding. Of the 81 cultivars indicated for planting by Embrapa Trigo, 34 are protected (MAPA 2018, Table 4, p. 10).

In spite of the effort already made in the Brazilian cerrado for development of wheat cultivars for irrigated and dryland regimes, both by Embrapa and other breeders, the area occupied in the region is not yet significant compared with traditional areas of southern Brazil. Since 1974, 16 wheat cultivars have been released for this region, of which only BRS 207, BRS 254, and BRS 264 are protected in MAPA (Table 5, p. 11). Currently, the CPAC concentrates its efforts on development of wheat cultivars for irrigated areas, with BRS 254 and BRS 264 standing out for high grain yield potential, a trait indispensable for disputing the space under irrigation pivots versus vegetable crops. For several years,

Table 4. Wheat cultivars released by Embrapa – Centro Nacional de Pesquisa de Trigo (CNPT) from 1990 to present, name of the pre-commercial line, and cross. Embrapa: Passo Fundo, RS, Brazil, 2018 ([P] = cultivar protected in the National Cultivar Protection Service (MAPA); [EP] = cultivar in the process of obtaining protection in MAPA).

Year	Cultivar	Line	Cross
1990	Trigo BR 36-Ianomami	PF 84588	Jupateco 73*3/Amigo
1990	Trigo BR 37	PF 84431	Mazoe/F13279//Pelado Marau
1990	Trigo BR 38	PF 83348	IAS 55*4/Agent//IAS 55*4/CI 14123
1991	Trigo BR 42-Nambiquara	PF 85634	Jupateco 73*6//Lagoa Vermelha*5/Agatha
1991	Trigo BR 43	PF 853031	PF 833007/Jacuí
1992	Embrapa 15	PF 85137	CNT 10/BR 5//PF 75172/Tifton 72-59 Sel
1992	Embrapa 16	PF 86238	Hulha Negra/CNT 7//Amigo/CNT 7
1993	Embrapa 24	PF 87128	Tifton 72-59 Sel/PF79763/3/Nobeoka Bozu/3*Londrina//B7908
1994	Embrapa 27	PF 869107	PF 83743/5/PF 83182/4/CNT 10*4//Lagoa Vermelha*5/Agatha/3/Londrina*4/Agent//Londrina*3/Nyu Bai
1995	Embrapa 40	PF 84316	PF 7650/NS 18-78//CNT 8/PF 7577
1996	Embrapa 52 [P]	PF 86242	Hulha Negra/CNT 7//Amigo/CNT 7
1996	BRS 49 [P]	PF 90120	BR 35/PF 83619//PF 858/PF 8550
1997	BRS 119 [P]	PF 9198	PF 82252/BR 35//Iapar 17/PF 8550
1997	BRS 120 [P]	PF 91205	PF 83899/PF 813//F27141
1999	BRS 176 [P]	PF 86247	Hulha Negra/CNT 7//Amigo/CNT 7
1999	BRS 177 [P]	PF 92093	PF 83899/PF 813//F27141
1999	BRS 179 [P]	PF 92140	BR 35/PF 8596/3/PF 772003*2/PF 813//PF 83899
2000	BRS 192 [P]	PF 93167	PF 869114/PF 8722
2000	BRS 194 [P]	PF 92231	CEP 14/BR 23//CEP 17
2002	BRS 209 [P]	PF 940384	Jupateco 73/Embrapa 16
2002	BRS Angico [P]	PF 960198	PF 87107/2*IAC 13
2002	BRS Figueira [P]	PF 950262	Coker 762*2/CNT 8
2002	BRS Timbaúva [P]	PF 950419	BR 32/PF 869120
2003	BRS 234 [P]	PF 950407	BR 35//Embrapa 27/Buck Ombu/3/PF 87511
2003	BRS Buriti [P]	PF 950400	Embrapa 27/Klein Orion
2003	BRS Camboatá [P]	PF 970151	PF 93232 Sel 14
2003	BRS Guabijú [P]	PF 970141	PF 86743/BR 23
2003	BRS Louro [P]	PF 970128	PF 869114/BR 23
2003	BRS Umbu [P]	PF 960243	Century/BR 35
2004	BRS Camboim [P]	PF 980144	Embrapa 27*4/K. Cartucho//PF 869114/BR 23
2004	BRS Canela [P]	PF 979064	BRS 120PF 91204*2//Anahuac 75
2004	BRS Guatambu [P]	PF 970285	Amigo/2*BR 23
2004	BRS Tarumã [P]	PF 970343	Century/BR 35
2005	BRS Guamirim [P]	PF 990407	Embrapa 27/Buck Nandu//PF 93159
2008	BRS 276	PF 980537	Embrapa 27*3/Klein H3247 a 33400PF 93218
2008	BRS 277	PF 990423	OR 1/Coker 97.33
2009	BRS 296 [P]	PF 990283	PF 93232/Cook*4/VPM1
2010	BRS 327 [P]	PF 030027	CEP 24 Sel/BRS 194
2012	BRS 328 [P]	PF 023186-C=A	Klein H 3394 a 3110/PF 990744
2012	BRS 331 [P]	PF 015733-C	PF 99602/WT 98109
2012	BRS 374 [P]	PF 040310	PF 88618/Coker 80.33//Frontana/Karl
2012	BRS Parrudo [P]	PF 070478	WT 98109/TB 0001
2013	BRS Marcante [P]	PF 080310	PF 980533/PF 970227//BRS Guamirim
2016	BRS Guaraim [P]	PF 080769	(Embrapa 27/Buck Nandu//PF 93159) Sel
2016	BRS Pastoreio [P]	PF 010066	Coker 80:33/BRS 194
2017	BRS Primaz	PF 110046	PF 980241/PF 980560
2017	BRS Belajoia	PF 101088	PF 001237/PF 980560

the cultivar Trigo BR 33-Guará was the most planted in Goiás and the Distrito Federal, mainly because of its agronomic characteristics and resistance to lodging under irrigation (Sousa 2004). Due to cooperative efforts with the CNPT, some lines (designated PF) resulted in cultivars indicated for dryland growing in Central Brazil, such as CNT 7, Trigo BR 8,

Table 5. Wheat cultivars released by Embrapa in the CPAC units from 1974 to 2018. Year of release, name of pre-commercial line, and cross. Embrapa: Passo Fundo, RS, Brazil, 2018 ([P] = Cultivar protected in the National Cultivar Protection Service (MAPA).

Year	Cultivar	Line	Cross
1978	Moncho BSB	—	Wren/Gaboto//Kalyansona/Blue Bird, Moncho Sib
1983	Trigo BR 9 – Cerrados	R 30469-77	BH 1146/IRN 595-71
1983	Trigo BR 10 – Formosa	R 30147-77	D6301/Nainari 60//Weique/Red Mace/3/Ciano*2//Chris, Alondra 4546 Sel
1985	Trigo BR 12 – Aruanã	—	Bucky/Maya 74 Sib/4/Blue Bird//HD 832-5-5-Olesen/3/Ciano/ Penjamo
1988	Trigo BR 26 – São Gotardo	CPAC 831243	Kavkaz/Buho Sib//Kalyasona/Blue Bird,Veery Sib
1989	Trigo BR 33 – Guará	CPAC 841222	Buckbuck Sib/Bluejay Sib
1991	Trigo BR 39 – Paraúna	CPAC 841244	Dove Sib/Pewee Sib
1993	Embrapa 21	CPAC 86133	PAT 10/Alondra Sib//Veery 5
1993	Embrapa 22	CPAC 841153	Veery Sib/3/KLTO Sib/PAT 19//Mochis/Jup. 73
1995	Embrapa 41	CPAC 88118	PF 813/Polo 1
1995	Embrapa 42	CPAC 88130	LAP 689/MS 7936
1999	BRS 207 [P]	CPAC 91086	Seri 82/PF 813
2005	BRS 254 [P]	PF 973047	Embrapa 22*3/Anahuac 75
2005	BRS 264 [P]	CPAC 98222	Buck Buck/Chiroca//Tui
2014	BRS 404 [P]	PF 100660	WT 99172/MGS 1 - Aliança
2016	BRS 394 [P]	CPAC 0544	Embrapa 22/CM 106793

Trigo BR 16-Rio Verde, Trigo BR 24, and Trigo BR 25 (Sousa 2004). As of 2012, a specific program, began in Uberaba by the creation of a Tropical Wheat Research Station, was connected with Embrapa Trigo for developing wheat cultivars for dryland conditions. The program has its own structure in Minas Gerais, from which promising results are expected through the aggregation of developed germplasm with additional multidisciplinary actions and through cultivars that exhibit greater adaptation to the growing system in the region.

Embrapa Soja (CNPSo) has a fundamental role as the research body connected with the national project of wheat breeding coordinated by Embrapa Trigo. From its activities, 14 wheat cultivars have been developed since 2000, all under the protection of MAPA (Table 6). Practically all the cultivars originating from this unit were derived from WT lines developed in Londrina and adapted to the main problems of the northwest region of Paraná, the important wheat production area of the state. Cultivars BRS 208 and BRS 220 may be highlighted and, more recently, BRS Tangará and BRS Pardela. All the cultivars were developed by Embrapa Soja, except for BRS 193 and BRS 208, resulted from a partnership with the Fundação Meridional de Apoio à Pesquisa (Meridional Research Support Foundation), in a manner similar to that of the partnership between Embrapa Trigo and the Fundação Pró-Sementes in Rio Grande do Sul. Nevertheless, in contrast with what occurred in RS, the partnership of Embrapa Soja with the Fundação Meridional still exists, and three other cultivars were released in recent years: BRS Gaivota, BRS Gralha Azul, and BRS Sabiá. The germplasm

Table 6. Wheat cultivars released by Embrapa in the CNPSo units from 1974 to 2018. Year of release, name of pre-commercial line, and cross. Embrapa: Passo Fundo, RS, Brazil, 2018 ([P] = Cultivar protected in the National Cultivar Protection Service – MAPA).

Year	Cultivar	Line	Cross
2000	BRS 193 [P]	PF 95068	Anahuac 75/PF 869100
2001	BRS 208 [P]	WT 96053	CPAC 89119/3/BR 23//CEP 19/PF 85490
2002	BRS 210 [P]	WT 96061	CPAC 89119/3/BR 23//CEP 19/PF 85490
2003	BRS 220 [P]	WT 98109	Embrapa 16/TB 108
2004	BRS 229 [P]	WT 96168	Embrapa 27*3//BR 35/Buck Poncho
2005	BRS 248 [P]	WT 99207	PAT 7392/PF 89232
2005	BRS 249 [P]	WT 00124	Embrapa 16/Anahuac 75
2007	BRS Pardela [P]	WT 02094	Trigo BR 18/PF 9099
2007	BRS Tangará [P]	PF 003295-A/B	BR 23*2/PF 940382
2011	BRS Gaivota [P]	WT 05106	PF 940301/PF 940395
2012	BRS Gralha Azul [P]	WT 07105	Jupateco F_3/Embrapa 16//BRS Camboatá/LR 37
2013	BRS Sabiá [P]	WT 08111	BRS 210/PF 980583
2014	BRS Graúna [P]	WT 10008	LD 975/WT 01121
2016	BRS Sanhaço [P]	WT 11167	BRS 220/BRS 210

used in the genetic makeup of the cultivars from Embrapa Soja is quite varied, Mexican (Anahuac 75 and Jupateco F3), Argentinian (Buck Poncho), and lines and cultivars from Embrapa and from other breeders, such as Fundacep (CEP) were used.

Another research branch of wheat breeding, Embrapa is the Centro de Pesquisa Agropecuária Oeste, is located in Dourados, MS. From there, nine wheat cultivars have been released since 1984 (Table 7). Nevertheless, since 1992, no other cultivars have been developed. The program lost strength because of the small demand for wheat in Mato Grosso do Sul and the surrounding region. Of all the CPAO cultivars, Trigo BR 18–Terena is the most important, and it is even internationally relevant. Developed for dryland in 1986, Trigo BR18–Terena is still the reference for growing under the dryland cultivation for the entire region of Mato Grosso do Sul, Goiás, and Minas Gerais, because of its tolerance to heat and low water availability, quality characteristics, and good plant architecture. Although its origin is unknown, the cultivare is still highly used in crosses in breeding programs. Because of the time since release, none of the cultivars from CPAO are protected, originating mainly in lines from Mato Grosso do Sul (MS lines).

Table 7. Wheat cultivars released by Embrapa in the CPAO units from 1974 to 2018. Year of release, name of pre-commercial line, and cross. Embrapa: Passo Fundo, RS, Brazil, 2018.

Year	Cultivar	Line	Cross
1984	Trigo BR 11 - Guarani	MS 7810	Bluebird//Tobari 66/8156
1986	Trigo BR 17 - Caiuá	MS 7878	Tezanos Pinto Prec//IRN 46/Ciano/3/II-64-27
1986	Trigo BR 18 - Terena	PF 781148	Unknown cross
1988	Trigo BR 29 - Javaé	MS 8166	Siskin Sib/Pavon Sib
1988	Trigo BR 30 - Cadiuéu	MS 81128	Ciano/8156//Tobari/Ciano/4/NO/3/II-12300//Lerma Rojo 64/8156/5/Pavon Sib
1988	Trigo BR 31 - Miriti	Veery 1	Kavkaz/Buho//Kalyansona//BB, Giennson 81
1991	Trigo BR 40 - Tuiúca	MS 208-84	Anahuac 7/Huacamayo Sib
1991	Trigo BR 41 - Ofaié	GD 833	BH 1146*6/Alondra Sib

Information of all the wheat cultivars released by Embrapa from 1974 to 2018, together with the year of release, the name of the pre-commercial line, the cross, and other information, will be useful for the production, academic, and research purposes. It addition, this is an important historical document of the work already performed by Embrapa in the genetic breeding of wheat in Brazil.

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ITEMS FROM GERMANY

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Adult yellow rust resistances from genetic resources of spring wheat from the IPK genebank.

Two DH populations of genetic resources of spring wheat from the IPK genebank (Population 1: 'TRI 11082 (GDR-variety HATRI) / TRI 5645 (from Iran, collected 1952-54)', 107 DH lines; population 2: 'TRI 10703 (from Greece) / TRI 5310 (cultivar EUREKE from France)', 159 DH-lines) were grown in the field at IPK in 2016. A naturally occurring yellow rust infection was scored on a scale of 1 to 7 at anthesis. Yellow rust resistance was segregating in both populations. The genotyping of both populations with the 15k ILLUMINA chip from TraitGenetics GmbH, Gatersleben, resulted in 3,877 polymorphic SNPs for population 1 and 3,906 polymorphic SNPs for population 2. In each population, one single sharp peak for yellow rust resistance could be mapped in a QTL scan using interval mapping (SIM) by the software package Genestat16. In population 1, the yellow rust resistance mapped to chromosome 2DS at 47 cM and came from parent TRI 11082. The yellow rust resistance of population 2 was derived from parent TRI 5310 and mapped on chromosome 5AL at 128 cM. We assume that, in both cases, the main adult-stage resistance genes are causing the resistance reaction. Possible candidates, based on map position, are *Yr16* for population 1 and *Yr48* or *Yr34* for population 2, but it also is possible that novel genes were detected. The significant physical interval for the genomic region on chromosome 2DS comprises 2.6 Mb, containing 62 predicted genes of which 23 genes are supported by cDNAs or ESTs. On chromosome 5AL, the significant interval of 6.6 Mb comprises 104 predicted genes of which 49 genes are supported by cDNAs or ESTs. Our results support the use of genetic resources as source of novel alleles and/or genes for resistances to biotic stress.