

Conatrigo F2015: a new variety of bread wheat for irrigation areas in Mexico

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Abstract

INIFAP makes available to irrigated wheat producers the variety ‘Conatrigo F2015’, obtained in the Wheat Genetic Improvement Program in the Valle de Mexico Experimental Field. The parents Thelin and Weebill were crossed in El Batán in S-S/2001, the F₁ was backcrossed to WEEBILL in Cd. Obregon in A-W/2001-2002. The F₁ TOP cross (CGSS02Y00079T) was sown in El Batán in S-S/2002, an indefinite number of plants were harvested in mass (099B), this procedure was followed alternately in El Batán, Atizapán and Cd. Obregon until F₅ was planted in Cd. Obregon, Son. In A-W/2004-2005, plant No. 6 (6Y) was individually selected and harvested, obtaining the line that gave rise to the variety. From the A-W/2007-2008 cycle to A-W/2014-2015 it was evaluated by INIFAP in ten states and up to 120 different conditions. Its genealogy is Thelin/2*Wbll1 and pedigree, CGSS02Y00079T-099B-099B-099Y-099M-6Y-0B. The definitive registration number is TRI-174- 231117 and breeder’s title 1895. It has the genes *Lr24* and *Lr46* that give resistance to the races of leaf rust present in Mexico. It has the *Yr29* and *Yr30* genes that confer resistance to yellow rust in adult plants. It surpassed in yield from 3% (Kronstad F2004) to 32% (Palmerin F2004) in normal irrigation. It is hard grain with strong dough ($W > 300 \text{ J} \times 10^{-4}$), extensible ($PL < 1$), bread volume greater than that of Kronstad F2004, with dough suitable for mechanized breadmaking or as a soft dough improver and tenacious.

Keywords: higher yield, irrigated wheat, leaf rust, yellow rust.

Reception date: October 2020

Acceptance date: November 2020

In Mexico, irrigated wheat production is of great importance in the national supply. The importance of this crop lies in the fact that it is used for human and animal nutrition and for the area sown. In 2018, about 560 thousand hectares were planted, of which 83.5% were irrigated, where the states of Sonora, Guanajuato, Baja California Norte, Sinaloa and Michoacán stand out in order of importance, and which together contributed 89.1% of the national supply, which was 3.3 million tons (SIAP, 2019).

Yellow rust (*Puccinia striiformis* f. sp. *tritici*) and leaf rust (*Puccinia triticina* E.) are the most important diseases that cause losses of up to 60% in wheat (Villaseñor-Espin *et al.*, 2009; Huerta *et al.*, 2009; Leyva *et al.*, 2003) the most effective control has been the sowing of resistant or tolerant varieties. INIFAP wheat genetic improvement program assesses materials against the natural incidence of such pathogens to release varieties that combine higher grain yield and greater resistance to diseases in the main wheat areas of Mexico.

This variety has excelled in more than 120 evaluations nationwide for its high grain yield and resistance to the different races of yellow and leaf rust that have prevailed in the country. Conatrigo F2015 has a spring habit, the experimental line was obtained at CIMMYT; subsequently, it was evaluated in the INIFAP irrigated wheat nurseries and national trials. It was obtained by hybridization, where the Thelin (parental A) and Weebill (parental B) progenitors were recombined in a simple cross, outstanding in the international trials of CIMMYT and the national trials of INIFAP for their resistance to yellow and leaf rust in its F₁ a retro cross was made to Weebill (parent C).

The simple cross was carried out in El Batán, Texcoco, Mex. in the S-S/2001 cycle and the backcross in Cd. Obregon, Son. in the A-W/2001-2002 cycle. The F₁ TOP cross identified as CGSS02Y00079T was sown in the F₁ (Top) generation in El Batán in the S-S /2002 cycle, where an indefinite number of plants (099B) were harvested in bulk, which gave rise to the F₂ generation, which was planted in El Batán, Texcoco, State of Mexico. in the S-S/2003 cycle, where an indefinite number of plants (099 B) were harvested in the same way.

The F₃ generation was evaluated in Cd. Obregon, Son. in the A-W/2003-04 cycle and an indefinite number of plants (099Y) were harvested in mass, which were sown in their F₄ generation during the S-S/2004 cycle in Atizapán, State of Mexico, selected and harvested with the same procedure previous (099M). The F₅ generation was sown in Cd. Obregon, Son., in the A-W/2004-2005 cycle, where plant No. 6 (6Y) was selected and harvested individually, which was planted in its F₆ generation in El Batán, Texcoco, State of Mexico in the S-S/2005 cycle under regular storm conditions, harvesting massively.

From the A-W/2007-2008 cycle to the A-W/2014-2015 cycle, it was evaluated by INIFAP in its national yield trials of irrigated flour wheat in ten states of the republic (Sin., Son., BCN, Chihuahua, Coahuila, Nuevo León, Tamaulipas, Guanajuato, Jalisco and Oaxaca) in up to 120 different conditions, under an alpha-late design with two replications, in 4.5 m² plots, as well as in their disease evaluation nurseries in the High Valleys from Mexico in the cycles S-S/2011 to S-S/2015 in two rows of one linear meter in the towns of Terrenate, Nanacamilpa, Francisco I. Madero, Huamantla, Benito Juárez, Emiliano Zapata, Lazaro Cárdenas in the state of Tlaxcala, while that in the state of Mexico were the towns of Chapingo, Santa Lucía, Coatepec, Miraflores, Tenango del Aire and Juchitepec.

It's genealogy is Thelin/2*Wb111 and pedigree; CGSS02Y00079T-099B-099B-099Y-099M-6Y-0B. It has a definitive registration number with the CNVV as TRI-174-231117 and with breeder's title number 1 895.

Conatrigo F2015 possesses the *Lr24* genes that confers resistance to the races of leaf rust that are currently prevalent in Mexico; however, virulence to *Lr24* has already been reported in the MFB/SP (Singh, 1991) and TNM/- - races (Huerta-Espino *et al.*, 2008). It also has the *Lr46* gene that gives it adult plant resistance.

This new variety manifested resistance to yellow rust in adult plant conferred by the *Yr29* and *Yr30* genes, among others, for which it exceeds the control varieties in both rusts, so it is inferred that it has horizontal resistance to the two pathogens (Singh, 1991; Huerta-Espino *et al.*, 2009), outperformed the varieties Kronstad F2003, Villa Juárez F2009 and Palmerin F2004, combining resistance to rusts and higher productivity (Table 1, Figure 1).

Table 1. Comparison of the benefits of the new variety Conatrigo F2015 with respect to control varieties, yield of cycles A-W/2007-2015 and reaction to rusts cycles S-S/ 1011-2015.

Variety	Yield (RN)	Yield (RL)	Leaf rust	Yellow rust
Conatrigo F2015	5 696	4 245	0-1R	0-15MR
Kronstad F2003	5 293	4 061	40MS-80S	0-60S
Villa Juarez F2009	4 980	3 994	0-10R	0-30MR
Palmerin F2004	3 743	3 043	0-10R	0-20MR

Yield= grain yield in kg ha⁻¹; RN= normal irrigation; RL= limited irrigation; R= resistant; MR= moderately resistant; MS= moderately susceptible; S= susceptible. Yield evaluations in Sinaloa, Sonora, BCN, Chihuahua, Coahuila, Nuevo León, Tamaulipas, Guanajuato, Jalisco and Oaxaca.



Figure 1. Detail of plant, spikes and bread of the Conatrigo F2015 variety.

Conatrigo F2015 exceeded in yield from 3% (Kronstad F2004) to 32% (Palmerin F2004) in normal irrigation (irrigation calendar 0-45-75-100). It was a consistent variety even after eliminating the last auxiliary irrigation (irrigation calendar 0-45-75), which coincides with the stage of filling grain to physiological maturity, since grain yield presented the same trend as in normal irrigation, since the differences were from 4.3 to 28.3% in the same varieties (Table 1).

It is hard grain with strong dough ($W > 300 \text{ J} \times 10^{-4}$) (Table 2), extensible ($PL < 1$), bread volume higher than that of Kronstad F2004, therefore, its dough is suitable for mechanized baking or as a soft and tough dough improver (Martínez *et al.*, 2016).

Table 2. Industrial quality of Conatrigo F2015 and control varieties under irrigation.

Genotype	DG	r	W	r	PL	r	VP	r
Conatrigo F2015	46	52-40	381	514-278	1	1.6-0.5	847	920-755
Borlaug 100 F2014	46	48-44	334	445-263	1	1.6-0.5	840	890-800
Villa Juárez F2009	42	47-38	342	488-237	1.3	2.2-0.8	734	745-720
Roelfs F2007	45	46-43	364	467-247	1	1.9-0.5	787	800-770
Kronstad F2004	40	45-36	426	550-300	1	1.3-0.7	827	855-790

DG= grain hardness (%); W= force of the mass (10^{-4} J); PL= toughness/extensibility ratio (0-7); VP= volume of bread (ml); r= range.

The Conatrigo F2015 variety is recommended for normal irrigation conditions and limited irrigation during the winter cycle in the states of Sinaloa, BCN, Chihuahua, Coahuila, Nuevo León, Tamaulipas, Guanajuato and Michoacán, for the northwestern, northern and northeastern states. It is recommended for early to late planting dates, while for the states of El Bajío it is recommended for early planting.

The seed of this new variety is available for those interested in the Bajío Experimental Field, in Roque, Guanajuato, as well as in the Valle de Mexico Experimental Field, located in Santa Lucía de Prías, Texcoco, Mex.

Conclusions

The Conatrigo F2015 variety surpassed the yield of commercial varieties currently in use in irrigated wheat producing areas from 3% to 33%, it is more efficient in the use of water, with resistance to yellow stripe and leaf rust. It is hard grain with a strong extensible dough and a bread volume greater than that of the control varieties, so its dough is suitable for mechanized bread making or as a soft and tough dough improver.

Acknowledgments

TO FONSEC SAGARPA-CONACYT (Project 146788) and MASAGRO Project WYC-2018-002 for the financing of national trials.

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