Revista Mexicana de Ciencias Agrícolas

DOI: https://doi.org/10.29312/remexca.v15i1.3137

Description of cultivar

Ibis M2016: a bread wheat variety with medium-strong gluten for El Bajío, Mexico

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Abstract

The Ibis M2016 variety is a bread wheat variety with medium-strong gluten that was obtained in the Wheat Genetic Improvement Program of the Bajío Experimental Field by hybridization through a simple cross between the Colibri and Finsi genotypes; its selection history is TC070080-2R-0C-0R-1CSE-0R. In plots of producers from El Bajío, it surpassed Cortazar S94 in grain yield by 23.8% and the varieties Alondra F2014, Luminaria F2012, Bárcenas S2002, Maya S2007, and Urbina S2007 by 3.4, 45.7, 41, 21.4, and 18.7%, respectively. It is moderately resistant to yellow rust; when Cortazar S94 reached 40% damage from the disease, Ibis M2016 showed damage ranging from 10 to 15%. The variety was developed from 2007, when the cross was made; in 2021, it was released as a commercial variety. Ibis M2016 was made available to producers to meet the demand for varieties with medium-strong gluten, resistant to rust, and with yields higher than those of commercial varieties. Ibis M2016 is recommended for sowing in the El Bajío region, which had altitudes of 1 500 to 1 800 m and includes part of the states of Guanajuato, Michoacán, Jalisco and Querétaro.

Keywords:

gluten, resistance, yield.

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The production of bread wheat (*Triticum aestivum* L.) in Mexico is insufficient since it only covers 25% of the national demand, and the grain necessary to cover its demand, which reaches seven million tonnes, is imported from the United States of America (SAGARPA, 2017). In Mexico, one of the main wheat-growing areas is El Bajío, which comprises part of the states of Guanajuato, Michoacán, Jalisco and Querétaro (Solís *et al*., 2018). During the 2019-2020 cycle, this region produced 686 483 t, representing 23.3% of national production (SIAP, 2022).

The main problems affecting wheat production in El Bajío are water scarcity, wheat stripe (yellow) rust, and drying caused by *Fusarium* spp. (Solís-Moya *et al*., 2013). For this reason, the objectives of the wheat genetic improvement program are aimed at generating high-yielding genotypes, of a specific quality; ie., quality demanded by the industry, resistant to diseases, and efficient in the use of water, which, with two irrigations (0 and 55 days), obtain a production close to 6 t ha^{-1} (the average wheat yield in Guanajuato is 6.6 t ha^{-1} applying four to five irrigations).

Wheat stripe rust affects the cultivars most widely sown in El Bajío, such as Cortazar S94, Bárcenas S2002, and Urbina S2007, which can present up to 60% severity with reductions in productivity of 10 to 50%, which depends on the phenological stage in which the maximum level of damage is reached. Given that, in recent years, at least three new breeds of wheat stripe rust have been detected, which in some cases have broken the resistance of the varieties one year after their release (Solís *et al*., 2016), it is necessary to have a group of genotypes with different combinations of genes of resistance to this pathogen that constitute a barrier against the disease and avoid reductions in the yield of the crop and the income of the producers.

Among the alternatives to solve the problem of wheat production in El Bajío, the National Institute of Forestry, Agriculture and Livestock Research (INIFAP, for its acronym in Spanish) recently released the variety of bread wheat (*Triticum aestivum* L.) Ibis M2016, which was registered and protected in the National Catalog of Plant Varieties (CNVV, for its acronym in Spanish) with the number TRI-162-230217 and was assigned the breeder's title 1697. Ibis M2016 was obtained in the Wheat Genetic Improvement Program of the Bajío Experimental Field by hybridization through a simple cross between the Colibri and Finsi genotypes; later, the selection was carried out until homozygosity was reached through the modified mass method.

The simple cross between its two parents was carried out in the autumn-winter (AW) 2006-07 cycle at the Bajío Experimental Field (CEBAJ, for its acronym in Spanish) and was identified with the number TC070080. The F1 generation was massively harvested in Texcoco, State of Mexico, during the spring-summer (SS) 2007 cycle; in the F2 generation, the plant identified as 2R was threshed individually in Celaya, Guanajuato, during the AW 2007-2008 cycle; in the SS 2008 cycle, the F3 was harvested massively in Texcoco, State of Mexico; the F4 was harvested massively in Celaya, Guanajuato, in the 2008-2009 cycle.

The F5 generation was sown in Texcoco, State of Mexico, during the SS 2009 cycle, and selection by spike was applied to the selected families; in this case, the spike identified as 1CSE was advanced as line F6. Finally, the F6 generation was massively harvested in Celaya, Guanajuato, during the 2009-2010 cycle as no noticeable phenotypic differences were found.

From the 2010-2011 cycle, it began to be evaluated in yield trials at CEBAJ and in the 2012-2013, 2013-2014, and 2014-2015 cycles in different localities in the El Bajío region. The selection history of the Ibis M2016 variety is TC070080-2R-0C-0R-1CSE-0R. Ibis M2016 is a variety of spring development, semidwarf, 91 cm tall; its vegetative cycle is intermediate, with 79 days to flowering and 134 days to physiological maturity. The spike is white, pyramidal, loosely dense, and bearded. The glumes are white and of medium width, the shape of the shoulder is straight, and the beak is medium in length and slightly curved in shape. The grain is white, with a weak reaction to phenol (Figure 1).

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Figure 1. Characteristics of Ibis M2016. a) pyramidal shape of the spike; and b) white spike at maturity.

The highest level of severity of wheat stripe rust in Ibis M2016 is 10%, according to the modified Cobb scale, which classifies it as moderately resistant to the disease. This variety has the Yr78 gene, an adult plant resistance gene located on chromosome 6B (Zhenzhen *et al*., 2017). It is more resistant to wheat stripe rust than the commercial cultivars currently in use, registering average values of less than 10% when the varieties Alondra F2014, Cortázar S94, and Luminaria F2012 reached values of 5, 20, and 43% of severity, respectively.

Ibis M2016 possesses the adult plant resistance gene for leaf rust Lr46. The highest level of severity it has had for this disease in assessments carried out in Texcoco, State of Mexico, is 10%, which indicates that it has adult plant genes not yet identified that confer high resistance. In sowing date evaluations (average of five sowing dates from November 15 to January 15, with 15-day intervals) during the cycles from 2012-2013 to 2015-2016, Ibis M2016 obtained a 29.4% higher yield than the Cortázar S94 variety, reaching yield maximums of 9 342 kg ha^{-1}.

When evaluating the Ibis M2016 variety with three irrigation calendars, the following results were obtained: in the first one, which consisted of two irrigations (0 and 55 days), it had a 4% higher yield performance against Cortázar S94, in the second, which consisted of three irrigations (0, 45, and 75 days), it surpassed it by 3%, and in the third, where four irrigations were applied (0, 45, 75, and 100 days), it achieved an outstanding production of 10% compared to Cortázar S94. On average, Ibis M2016 achieved a 6% increase in its production performance.

In plots of producers, Ibis M2016 surpassed Cortázar S94 in grain yield by 23.8%, and the varieties Alondra F2014, Luminaria F2012, Bárcenas S2002, Maya S2007, and Urbina S2007 by 3.4, 45.7, 41, 21.4, and 18.7%, respectively.

The interaction of 14 environments and nine varieties was analyzed using the AMMI model. The results showed that the Ibis M2016 and Alondra F2014 varieties obtained the highest yield, followed by Bárcena S2002; on the other hand, Eneida F94 expressed the lowest values. The Abasolo 2016-2017 environment was the one that achieved the highest yield, while Valle de Santiago 2014-2015 recorded the lowest.

Five environments showed productive behaviors equal to or above the average, and in the rest, they were lower. The most stable varieties, with PC1 (principal component 1) values low or near zero, were Bárcenas S2002, Urbina S2007, Maya S2007, Salamanca S75, and Luminaria F2012.

Ibis M2016 was the one with the highest yield and was not so far from line 0 of PC1, indicating that it is a variety that performs well in all environments. Cortázar S94 and the environments of

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Salamanca 2016-2017, Valle de Santiago 2014-2015, and Abasolo 2016-2017 were the ones that contributed the most to the first axis of interaction, as they were more unstable.

The Ibis M2016 grain is semihard, with a pearling rate of 43%. Its hectoliter weight is 77.3 kg hl^{-1}. Ibis M2016 flour is made of medium-strong gluten, with an average W value of $264x10^{-4}$ J, a P/G value of 4; it has a sedimentation rate of 37 cc, and an average percentage of protein in grains of 11.9%; its high extensibility allows obtaining bread volumes > 802 ml (Zeleny, 1978), with a P/L index of 0.8.

It has the allelic combinations of high molecular weight glutenins 2*, 17+18, and 2+12, which have been associated with weak and medium-strong gluten wheats, which have an adequate dough strength for making cookies, cakes, and bread in the small and medium-scale industry (Martínez *et al*., 2010; Martínez *et al*., 2013). The flour of this variety is suitable for baking in the semi-mechanized or manual industry and as an enhancer of tenacious and strong doughs in the mechanized industry.

Conclusions

Ibis M2016 can be sown from November 16 to December 31; nevertheless, its optimal sowing date is the first half of December, when it can reach yields of 9 t ha^{-1}. The technological package for this variety includes a schedule of four irrigations at 0, 45, 75, and 100 days after sowing and a fertilization dose of 240-60-00, with the application of all the phosphorus and half of the nitrogen at sowing and the rest of the nitrogen at the first supplemental irrigation.

Ibis M2016 adapts to sowing in the El Bajío region, with altitudes of 1500 to 1800 masl, average temperature of 20 °C, and rainfall of 450 to 650 mm. In Guanajuato, it can be sown in DDRs 003, 004, and 005, which include the provinces with good and very good productivity.

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DOI: https://doi.org/10.29312/remexca.v15i1.3137

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DOI: https://doi.org/10.29312/remexca.v15i1.3137

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Journal Information
Journal ID (publisher-id): remexca
Title: Revista mexicana de ciencias agrícolas
Abbreviated Title: Rev. Mex. Cienc. Agríc
ISSN (print): 2007-0934
Publisher: Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias

Article/Issue Information
Date received: 01 January 2024
Date accepted: 01 February 2024
Publication date: 15 February 2024
Publication date: January 2024
Volume: 15
Issue: 1
Electronic Location Identifier: e3137
DOI: 10.29312/remexca.v15i1.3137

Categories

Subject: Description of cultivar

Keywords:

Keywords:

gluten
resistance
yield

Counts

Figures: 1
Tables: 0
Equations: 0
References: 9
Pages: 0