

## Zermeño S2025: a weak-gluten bread wheat variety for El Bajío, Guanajuato

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### Abstract

The Zermeño S2025 variety was developed by the El Bajío Irrigated Wheat Genetic Improvement Program of the National Institute of Forestry, Agricultural and Livestock Research, and is registered in the National Catalog of Plant Varieties (CNVV) with the number TRI-218-030725. The Zermeño S2025 variety yielded 18.41% more than the Cortazar S94 variety under different planting dates and under deficit irrigation, it exceeded the Cortazar S94 variety by 11%. It is resistant to stripes or yellow rust and leaf rust. It is considered to be of excellent quality for the cookie industry. It is recommended for the region called El Bajío, which includes parts of the states of Guanajuato, Michoacán, Jalisco and Querétaro.

### Keywords:

Bajío, cookie quality, resistant, yield.

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## Description

Conventional wheat (*Triticum* spp.) breeding is essential to increase crop productivity and ensure food security in the face of growing population demand and to counteract the effects of climate change (Selva *et al.*, 2020).

In Mexico, the National Institute of Forestry, Agricultural and Livestock Research (INIFAP) has three centers that generate wheat varieties according to the climatic conditions in the areas in which they are located, since the physiological behavior and production of wheat crops varies considerably with the environment and the type of soil, temperature, pH, organic matter and humidity regime, which are environmental factors on which its physiological behavior and production depend (Ahlawat *et al.*, 2022).

Therefore, it is essential to continue producing germplasm and wheat varieties that adapt to climatic conditions and offer high yields across different growing areas, which differ in environmental conditions, to ensure profitability in wheat production and safeguard the population's food security.

El Bajío is one of the most important areas for wheat production in the country; this region includes parts of the states of Querétaro, Jalisco, Guanajuato and Michoacán and contributed 12.64% of the national total in 2024 (SIAP, 2025).

This region is home to one of INIFAP's wheat variety generation centers; this experimental station addresses problems in the area, such as water scarcity, rising temperatures and diseases, such as yellow rust (*Puccinia striiformis* f. sp. *tritici*) and wheat wilt (*Fusarium* spp.). In addition, it focuses on what the industry demands (especially varieties for bread and cookie making) and on obtaining high yields to make wheat production profitable.

In 2025, the El Bajío Irrigated Wheat Genetic Improvement Program of INIFAP released the bread wheat variety Zermeño S2025, which was registered and protected in the National Catalog of Plant Varieties (CNVV) under the number TRI-218-030725.

Zermeño S2025 was obtained by hybridization from a single cross between the Diamond/Sylvinite and Celestine genotypes and selection was then carried out until homozygosity was achieved using the modified mass breeding method.

The single cross was made in the autumn-winter (A-W) 2009-2010 cycle in Roque, Celaya, Guanajuato; the F1 generation of the cross was planted in A-W 2010-2011 in Roque, Celaya, Guanajuato and was identified with the number 143. In the segregating generations, the methods of mass selection and individual selection were applied.

The population in the F2 generation was identified with the number 2142 and was planted in Chapingo, Texcoco, State of Mexico, under rainfed conditions, in clumps, in the spring-summer (SS) 2011 cycle; 100 spikes of different plants were selected for resistance to diseases and agronomic type, and a balanced compound was made.

The F3 generation family was planted in A-W 2011-2012 in Roque, Celaya, Guanajuato, in clumps; 100 spikes of different plants were selected for disease resistance and agronomic type, and the seed was used to make a balanced compound.

F4 was evaluated in SS-2012 in the locality of Chapingo, Texcoco, State of Mexico; from this population, the best plants were selected for resistance to leaf and yellow rusts and by agronomic type; the best 100 plants were selected, and a spike was harvested per plant; the seed was used to form a balanced compound.

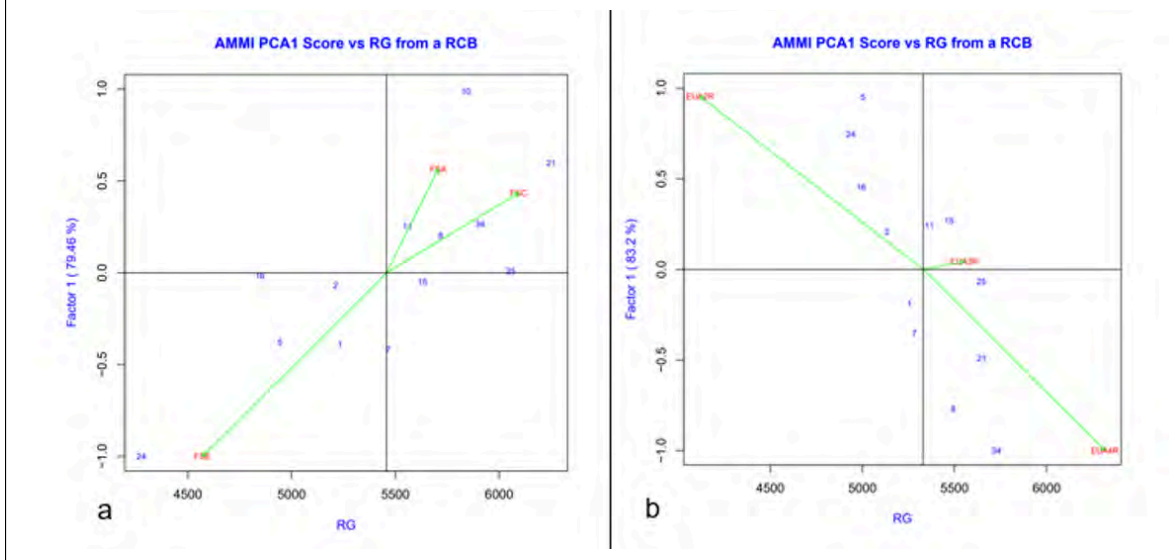
The F5 generation was planted in clumps during the AW 2012-2013 cycle in the locality of Roque, Celaya, Guanajuato and was identified with the number 5237; in this generation, the best 10 plants were selected, and spikes were harvested individually by plant.

The F6 generation was planted in a row per spike in SS-2013 in Chapingo, State of Mexico, where line 2 was selected and harvested. This line was evaluated in the preliminary yield trials in the AW 2013-2014 cycle in Roque, Celaya, Guanajuato. Later, it was evaluated in experiments of planting dates and irrigation calendars, as well as in nurseries for disease evaluation.

The Zermeño S2025 variety is a spring-developing, semi-dwarf variety, 91 cm tall; its vegetative cycle is Muscle-intermediate, with 80 days to flowering and 128 days to physiological maturity. The spikes are white, pyramidal, with sparse density and awns. The glumes are white with a narrow shoulder width, the shoulder shape is slightly inclined, the tip length is medium, and the tip shape is slightly curved. The grain is white and has a medium reaction to phenol.

The Zermeño S2025 variety (21, number assigned in Figures 1a and 1b) was compared against 11 commercial wheat varieties planted in El Bajío on planting dates and irrigation calendars during the A-W cycles from 2015-2016 to 2022-2023, in 58 environments or production conditions for El Bajío, Mexico; the control varieties were Cortazar S94 (1), Urbina S2007 (2), Maya S2007 (5), Bárcenas S2002 (7), Ibis M2016 (8), Alondra F2014 (11), Faisán S2016 (15), Salamanca S75 (16), Luminaria F2012 (24), Cisne F2016 (25), and Elia M2016 (34). As a result of these evaluations, it was observed that the new variety Zermeño S2025 exceeded the yield of Cortazar S94 by 18.41%, which is the most planted variety in the El Bajío area.

**Figure 1. a) Biplot of the yield of the Zermeño S2025 variety for planting dates. Cortazar S94 (1), Urbina S2007 (2), Maya S2007 (5), Bárcenas S2002 (7), Ibis M2016 (8), Alondra F2014 (11), Faisán S2016 (15), Salamanca S75 (16), Zermeño S2025 (21), Luminaria F2012 (24), Cisne F2016 (25) and Elia M2016 (34); FSA= November 15; FSC= December 15; FSC= January 15; b) Biplot of the yield of the Zermeño S2025 variety for irrigation calendars. EUA2R= calendar of two irrigations, 0 and 55 days; EUA3R= calendar of three irrigations, 0-45-75 days; EUA4R= calendar of four irrigations, 0-45-75-100 days; RG= grain yield in kg ha<sup>-1</sup>.**



When comparing Zermeño S2025 with the control varieties in a two-irrigation calendar (0-55 days), this new variety obtained a yield of 4 348 kg ha<sup>-1</sup>, outperforming the Cortazar S94 variety by 11%; with a three-irrigation calendar (0-45 and 75 days), Zermeño S2025 obtained a yield of 5 761 kg ha<sup>-1</sup>, exceeding the yield of the Cortazar S94 variety by 2.6%.

The Zermeño S2025 variety yielded 6 835 kg ha<sup>-1</sup> under a four-irrigation calendar (0-45-75 and 100 days) and surpassed the Cortazar S94 variety by 9.6%. Regarding the average of the three irrigation calendars, Zermeño S2025 outperformed the Cortazar S94 variety by 8%.

In Figures 1a and 1b, show the behavior of the commercial varieties and Zermeño S2025 in different environments; it can be observed that the varieties with the highest yield were Zermeño S2025 (21), Cisne F2016 (25) and Elia M2016 (34) in environments of planting dates and irrigation calendars. All varieties have a stable behavior. The varieties expressed their highest yield when planted on December 15 (FSC) and using the calendar of four irrigations at 0-45-75 and 100 days (EUA4R).

The Zermeño S2025 variety was selected in the segregating generations for resistance to rusts, so, when climatic conditions are present and the pathogen is present in the area, this variety only reaches 3% damage by yellow rust; on the contrary, older varieties such as Cortazar S94 and the susceptible variety Luminaria F2012 reach damage of 40% and 100%, respectively.

Most rust resistance genes are breed-specific and confer a major effect on resistance from the seedling stage to the adult plant stage; however, this type of resistance is not very durable, as the pathogen can evolve into virulence and overcome these resistance genes, which are usually used individually. On the other hand, partial or slow infection resistance is also known as non-specific breed resistance and is generally associated with durable resistance and commonly referred to as adult plant resistance because it is expressed as a slow development of the disease in the field; however, when three or more are combined, they add their effects and are inherited as a quantitative characteristic (Sandoval-Sánchez *et al.*, 2019).

In adult plants, the presence of Yr29 (gene of adult plant resistance to yellow or stripe rust) was determined using molecular markers; William *et al.* (2003) used AFLP markers to map Lr46 (leaf rust resistance gene) at the distal end of 1BL (long arm of chromosome 1B) and they found that Lr46 was closely linked or pleiotropic to a yellow or stripe rust resistance gene called Yr29.

The hectoliter weight of 78 kg hl<sup>-1</sup> of the Zermeño S2025 cultivar is similar to that of controls with medium-gluten wheat and is slightly higher than the specific values of the Mexican Standard NMX-FF-036-1996, which governs the marketing of wheat at the national level (DGN, 1996).

According to its average pearling index of 61%, the grain of the Zermeño S2025 cultivar is soft. Its protein content is similar to that of Faisán S2016; flours with a protein percentage greater than 9% are preferred for cookie production due to their ability to provide a proper structure and proper handling of the dough. On the other hand, those with lower protein content are more suitable for pastry making, where a softer texture is sought.

In the specific case of Zermeño S2025 flour, its average gluten strength (W) of 182 x 10<sup>-4</sup> J classifies it as a weak-gluten wheat. This characteristic is consistent with the grain's softness, which means that its use can be more advantageous in products where a softer and less elastic crumb is desired, such as in certain types of cakes or soft cookies. Selecting the right flour is therefore crucial for achieving the desired sensory and structural properties in bakery products and understanding these technical characteristics allows optimizing production processes and improving the final product's quality.

The cookie factor of the Zermeño S2025 variety was similar to those of the Cortazar S94 and Faisán S2016 control varieties. The cookie factors of the new soft wheat variety Zermeño S2025 corresponded to the rating of 'excellent cookie quality'. The new variety Zermeño S2025 is recommended for the region called El Bajío, which includes parts of the states of Guanajuato, Michoacán, Jalisco and Querétaro, with altitudes of 1 500 to 1 800 m, an average temperature of 20 °C, and rainfall of 450 to 650 mm.

## Conclusions

The Zermeño S2025 variety is an outstanding option for producers in the El Bajío region for sowing in the autumn-winter cycle, under irrigated conditions (SIAP, 2025).

One of its great advantages over other varieties in the area is its resistance to yellow rust. The yields of Zermeño S2025 are acceptable even under restricted irrigation, adapting well to the variations in water availability experienced in El Bajío. It is emerging as an efficient and reliable variety for farmers looking to maximize their production.

In terms of quality, Zermeño S2025 stands out for its suitability for cookie making and its ability to improve tenacious and strong doughs in the mechanized industry. This makes it attractive not only to producers but also to industrialists seeking high-quality ingredients for their products. Zermeño S2025 is a variety that offers benefits in both yield and quality, making it a strategic choice for farmers and the food industry.

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