

# Evaluation of jalapeño pepper genotypes (*Capsicum annuum* L.) for the Planicie Huasteca

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## ABSTRACT

**Objective:** This study aimed to evaluate the yield and fruit quality of jalapeño pepper genotypes cultivated in the Planicie Huasteca region.

**Design/Methodology/Approach:** Eight jalapeño pepper genotypes were assessed under open-field conditions, with the Orizaba genotype serving as the regional control.

**Results:** The Mixteco hybrid exhibited the highest yield along with favorable fruit characteristics, making it a viable option for cultivation in the Planicie Huasteca. Although the regional control, Orizaba, produced lower yields compared to Mixteco, its superior fruit quality continues to position it among the preferred genotypes for growers in this region.

**Limitations/Implications:** One of the limitations of this study is that the evaluation was conducted under specific environmental and management conditions in the Planicie Huasteca. Therefore, the performance of the genotypes may vary in other agroecological zones. Future trials across multiple locations and seasons are necessary to confirm the stability and adaptability of the evaluated materials. Nonetheless, the results provide valuable insight for local producers seeking high-performing jalapeño hybrids suited to regional market demands.

**Findings/Conclusions:** The findings of this study provide valuable information for producers when selecting jalapeño hybrids tailored to their production systems and specific market niches.

**Keywords:** Hybrid, Chile, fruit quality.

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## INTRODUCTION

Chili pepper (*Capsicum* sp.) is one of the most widely cultivated vegetables worldwide. Native to South America, the genus comprises approximately 30 species, of which only five have been domesticated. It is considered one of the most important vegetables globally due to its significant economic value (Benson *et al.*, 2014; Hernández, 2018), and it exhibits variation in both bioactive compounds and phenological traits (Martínez-Damián *et al.*, 2019). China is the leading producer of chili peppers, with approximately 17 million tons of fresh fruit annually (FAO, 2024). In Mexico, production reached



around 3 million tons last year (FAOSTAT, 2023). In Mexico, chili cultivation holds substantial economic, social, and cultural importance, generating employment for approximately 15 million workers. As such, chili production represents a major source of income for rural families (SIAP, 2023). Chili peppers are typically classified into two main categories: those consumed fresh and those consumed dried. Among them, the jalapeño variety accounts for the highest production value in Mexico, generating nearly 8 billion pesos. It is marketed in various forms, including fresh, chipotle, and as a raw material for sauces and pickled products, among others (OECD, 2021; SIAP, 2023). Currently, market demand emphasizes uniform, high-quality fruits, which are achieved through genetic improvement programs aimed at developing new varieties or hybrids (Vázquez, 2015). These materials are evaluated across different regions to determine their adaptability, growth, development, yield, and product quality. Such evaluations build confidence in replacing traditionally cultivated genotypes with improved ones (Macías *et al.*, 2012). In the state of Tamaulipas, chili peppers are cultivated on 3,300 to 4,000 hectares, of which 40% are dedicated to jalapeños. The most important production zone is located in the southern part of the state, within the municipalities of González, Altamira, Mante, and Llera, where over 80% of the area is concentrated (Vázquez *et al.*, 2015; SIAP, 2023). On-site varietal validation trials serve as a practical and effective tool, demonstrating cultivar characteristics such as adaptation and yield potential. These trials offer producers greater confidence in selecting seeds with optimal agronomic traits for specific production zones, thus facilitating the introduction of new crops or varieties, or the replacement of existing ones (Vargas & Cárdenas, 2021). Based on the above, the aim of this study was to evaluate the yield and fruit quality of jalapeño pepper genotypes for the Planicie Huasteca region.

## MATERIALS AND METHODS

### Experimental site

This research was conducted during the 2023-2024 fall-winter (O-I) growing cycle at the Las Huastecas Experimental Station, part of the National Institute for Forestry, Agricultural and Livestock Research (INIFAP). The station is located at Km 55 of the Tampico-Mante highway in Villa Cuauhtémoc, Altamira, Tamaulipas, at coordinates 22° 33' 59" N and 98° 09' 49" W, within the Huasteca region, at an elevation of 11 masl. The genetic material consisted of eight jalapeño pepper genotypes: Mixteco, Kronos, EXP-3482, Orizaba (regional check), Jerarca, Gabino, Buelna, and Catarino.

These were established under open-field conditions, with Orizaba serving as the regional control. Seedlings were raised in trays filled with peat moss, pre-moistened using a solution of 200 mL of a biofungicide based on *Bacillus subtilis* spores and 200 mL of rooting and growth promoter, prepared in 10 L of water. Seeds were sown at a depth twice their size. After 45 days, seedlings were transplanted in a randomized complete block design with three replications.

Each experimental plot consisted of a raised bed measuring 1.84 m in width and 4.0 m in length. Four harvests were performed at intervals of 20 to 25 days. The useful plot area was 5.52 m<sup>2</sup>, taking 3 m from the center of the bed. Crop management followed the

technological package for chili production developed by INIFAP (Ramírez *et al.*, 2015). The variables evaluated included total yield ( $\text{t ha}^{-1}$ ) and fruit characteristics: length (cm), diameter (cm), average weight (g), number of locules, and pericarp thickness (mm). Data were analyzed using a randomized complete block design, and mean comparisons were performed using Tukey's test ( $P \leq 0.05$ ) with the SAS statistical software (SAS Ver., 2004).

## RESULTS AND DISCUSSION

Statistical analyses revealed significant differences ( $p \leq 0.05$ ) among the evaluated genotypes for fruit quality traits and yield (Table 1), likely due to morphological differences among the jalapeño genotypes (Mis-Valdez *et al.*, 2022). According to Tukey's 0.05% mean comparison test, the Mixteco hybrid recorded the highest yield at  $70.02 \text{ t ha}^{-1}$ , followed by Kronos ( $63.38 \text{ t ha}^{-1}$ ) and EXP-3482 ( $55.80 \text{ t ha}^{-1}$ ). The remaining varieties yielded between  $49.49$  and  $35.90 \text{ t ha}^{-1}$ . Santamaría *et al.* (2021) conducted an evaluation in Quintana Roo comparing INIFAP-developed jalapeño varieties with commercial hybrids, and reported yields of  $21 \text{ t ha}^{-1}$  for both Mixteco and Orizaba values well below those obtained in this study. These discrepancies may be attributed to management practices and the edaphoclimatic conditions of the production sites, although the yield potential of these two genotypes is notable. Regarding fruit quality, the Buelna and Catarino hybrids produced the longest fruits (11.44 and 11.27 cm, respectively). The Mixteco, EXP-3482, and Jerarca hybrids also produced large fruits, ranging from 10.83 to 10.68 cm, comparable to those in the top statistical group (Group A). These hybrids were classified as extra-large based on the Mexican Standard NMX-FF-025-SCFI-2014 (Secretaría de Economía, 2014), as most fruits measured over 9 cm. These results differ from those reported by Santamaría *et al.* (2021), where Mixteco fruits were predominantly classified as large, and Orizaba fruits were medium-sized. Sánchez *et al.* (2019), in a study on consumer preferences, found that consumers value fruit quality traits differently depending on the marketing region. This finding supports the selection of varieties that align with market demands and consumer expectations when establishing new plantations. Regarding average fruit weight, Jerarca and EXP-3482 produced the heaviest fruits, with weights of 27.99 and 25.99 g, respectively. Kronos yielded the lightest fruits, averaging 15.36 g.

According to Ramírez and Méndez (2019), average fruit weight is a high-value trait closely associated with yield. However, in this study, that relationship was not observed, as Mixteco the highest-yielding genotype did not produce the heaviest fruits. This may be attributed to the fact that Jerarca and EXP-3482 produced fewer but larger fruits. Additional fruit traits such as fruit diameter, number of locules, and pericarp thickness were also analyzed. Buelna exhibited the greatest fruit diameter (3.94 cm), Catarino had the highest number of locules (3.89), and EXP-3482 stood out for pericarp thickness (0.66 cm). The Mexican standard specifies that pericarp thickness should range between 0.4 and 0.6 cm; all genotypes in this study met or exceeded this standard, consistent with the findings of Santamaría *et al.* (2021).

**Table 1.** Characteristics of Jalapeño Pepper Hybrids for the Fresh Market.

Genotype Mixteco	Yield (t ha <sup>-1</sup> )		Fruit Length (cm)		Fruit Diameter (cm)		Fruit Weight (g)		Number of Locules		Pericarp Thickness (cm)	
	70.02 A	9.59 B	10.83 AB	1.90 D	3.78 ABC	3 AB	18.10 BC	3 AB	3 AB	0.54467 AB		
Kronos	63.38 B	9.59 B	15.35 C	1.90 D	0.22233 C	2 B	63.38 B	9.59 B	1.90 D	15.35 C	2 B	
EXP-3482	55.80 C	10.73 AB	25.99 A	3.57 ABC	0.66667 A	3 AB	55.80 C	10.73 AB	3.57 ABC	25.99 A	3 AB	
Orizaba (C)	49.49 D	9.62 B	24.54 AB	3.90 AB	0.51100 AB	3 AB	49.49 D	9.62 B	3.90 AB	24.54 AB	3 AB	
Jerarca	44.26 E	10.68 AB	27.99 A	3.46 BC	0.51100 AB	3 AB	44.26 E	10.68 AB	3.46 BC	27.99 A	3 AB	
Gabino	41.52 F	9.64 B	20.74 ABC	3.33 C	0.44467 B	3 AB	41.52 F	9.64 B	3.33 C	20.74 ABC	3 AB	
Buelna	40.19 G	11.44 A	18.33 BC	3.94 A	0.56267 AB	3 AB	40.19 G	11.44 A	3.94 A	18.33 BC	3 AB	
Catarino	35.90 H	11.27 A	21.67 ABC	3.89 AB	0.54433 AB	4 A	35.90 H	11.27 A	3.89 AB	21.67 ABC	4 A	
Genotype	Yield (t ha <sup>-1</sup> )	Fruit Length (cm)	Fruit Diameter (cm)	Fruit Weight (g)	Number of Locules	Pericarp Thickness (cm)	Genotype	Fruit Length (cm)	Fruit Diameter (cm)	Fruit Weight (g)	Number of Locules	

Means with the same letter within a column are not significantly different (Tukey,  $\alpha=0.05$ ). Yield values are based on three harvests. C=Regional check (control).



**Figure 1.** A) Jalapeño pepper plant of the Mixteco variety; B) Jalapeño pepper plant of the Orizaba variety.

## CONCLUSIONS

The Mixteco jalapeño hybrid demonstrated high yield potential, superior quality standards, large and thick fruits, and a robust pericarp traits highly demanded by the fresh green chili market. Based on its yield performance and fruit quality, Mixteco is recommended for cultivation in the Planicie Huasteca as a viable alternative to the currently established regional variety, Orizaba.

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