

Quality and yield of two fig varieties (*Ficus carica* L.) under intensive management in greenhouse conditions

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ABSTRACT

Demand for fresh and processed figs (*Ficus carica* L.) is increasing annually in both domestic and international markets. Mexico has the potential to become a major global producer. However, open-field cultivation poses phytosanitary and climatological control challenges; therefore, the adoption of technologies such as greenhouse production constitutes a viable alternative for increasing fig fruit yield and quality in a profitable and sustainable manner.

Objective: To evaluate the performance and quality of two fig varieties under intensive management in greenhouse conditions.

Design/methodology/approach: The experiment was conducted at the Higher Technological Institute of Eldorado, in Eldorado, Sinaloa, Mexico (24°19' 28" N, 107° 22' 01" W; 11 m above sea level). The fig varieties Netzahualcoyotl and Black Mission were planted at a spacing of 1.0 m between plants and 1.80 m between rows in a greenhouse with a plastic roof, 6 m in height, and vertical walls covered with aphid-proof mesh. The crop was managed with eight stems per plant and 20 fruits per stem. The variables evaluated were yield, fruit weight, total soluble solids (°Brix), and the polar and equatorial diameters of the fruit.

Results: Statistical analysis revealed significant differences between the Netzahualcoyotl and Black Mission varieties for yield, polar diameter, equatorial diameter, and fruit weight. The Netzahualcoyotl variety exhibited greater polar and equatorial fruit diameters (50 and 54 mm, respectively) than the Black Mission variety (42 and 47 mm, respectively). Likewise, Netzahualcoyotl showed higher fruit weight and yield (70 g and 62 t ha⁻¹, respectively) compared with Black Mission (52 g and 46 t ha⁻¹, respectively). No significant differences were observed between the two varieties in terms of fruit total soluble solids (°Brix).



Limitations on study/implications: The fig fruits used for sampling were processed as rapidly as possible due to their high perishability.

Findings/conclusions: The Netzahualcoyotl variety exhibited superior yield compared to the Black Mission variety, mainly as a result of its greater polar and equatorial fruit diameters and higher fruit weight.

Keywords: Black Mission, Netzahualcoyotl, °Brix, intensive management.

INTRODUCTION

Ficus carica L. production in Mexico reached 12,000 tons in 2020, harvested from 1,843 hectares, with an average yield of 6.5 t ha⁻¹. The state of Morelos is the leading fig producer in Mexico, with 4,276 tons, followed by Veracruz with 2,601 tons and Michoacán with 1,533 tons; together, these three states account for 70% of national production (Ollaquindia, 2020). However, open-field production presents several constraints, including fruit rot during the rainy season, the incidence of certain pests and diseases, damage caused by frost, and inadequate crop management. These factors result in low yields and, consequently, crop abandonment, as production becomes economically unprofitable. The need to increase fig yield has led to the implementation of techniques such as fertigation, increased planting density, management of the number of productive branches, and pruning practices, among others. One important aspect to consider is that fig cultivation requires high heat unit accumulation to achieve good fruit quality (Stover *et al.*, 2007), which limits its production in regions characterized by low temperatures. Greenhouse production is regarded as a technological system that allows for the management of environmental conditions and other risks, such as pests and diseases, thereby promoting adequate crop development. As a result of this technological approach, improvements in both yield and commercial quality can be achieved (Moreno *et al.*, 2011; Vargas-Canales *et al.*, 2014). Therefore, the aim of this study was to evaluate two fig varieties (*Ficus carica* L.) under greenhouse conditions in an intensive production system.

MATERIALS AND METHODS

The study was conducted at the Higher Technological Institute of Eldorado, located in the municipality of Eldorado, Sinaloa, Mexico. The fig varieties evaluated were Black Mission and Netzahualcoyotl, which were established at a spacing of 1.0 m between plants and 1.80 m between rows in a greenhouse with a plastic cover, simple-zenith type, a roof height of 6 m, and vertical walls fitted with aphid-proof mesh. Average temperatures ranged from 30 to 35 °C, with relative humidity between 60 and 80%. The crop was grown in soil and managed with eight stems per plant and 20 fruits per stem. Irrigation was supplied through drip irrigation, with fertilization applied via the irrigation system using Steiner's universal nutrient solution (Steiner, 1961). The variables measured were total soluble solids (°Brix), fruit polar diameter, fruit equatorial diameter, fruit weight, and yield (t ha⁻¹). A completely randomized experimental design was used, with two treatments and 10 replications. The treatments were as follows: T1, Netzahualcoyotl variety; and T2, Black Mission variety. Six fruits per tree were selected to evaluate the study variables. For total soluble solids (°Brix), one drop of fruit juice was placed on a HANNA digital refractometer,

model HI 96801. Fruit polar and equatorial diameters were measured in millimeters using a MITUTOYO digital vernier caliper. Fruit weight (g) was determined using a RHINO digital scale, and fruit yield was expressed in tons per hectare ($t\ ha^{-1}$). Yield was calculated by multiplying fresh fruit weight by the number of fruits per plant and by planting density. Analysis of variance and mean comparison for the variables under study were performed using the experimental design software, version 1.0, developed by the Faculty of Agronomy of UANL, Marín, Nuevo León, by Olivares (2012). Tukey's test ($p < 0.05$) was used for mean comparison.

RESULTS AND DISCUSSION

Polar and Equatorial Fruit Diameter (mm)

Statistical analysis revealed significant differences between fig varieties (T1 and T2) with respect to fruit polar diameter (FPD) and fruit equatorial diameter (FED). Under greenhouse conditions and with eight stems per plant, the Nezhualcóyotl variety exhibited the greatest FPD (50 mm) and FED (54 mm) compared with the Black Mission variety (Figure 1). The fruit polar diameter of the two varieties evaluated ranged from 50 mm to 42 mm, in comparison with Karadeniz (2008), who reported that genotypes from the Black Sea region in Turkey had a polar diameter ranging from 60 mm to 33 mm. Regarding fruit equatorial diameter, the values obtained ranged from 54 mm to 47 mm, compared with those reported by Darjazi (2011), who found fruits with an equatorial diameter ranging from 21 mm to 45 mm.

Fruit Weight (g)

Statistical analysis revealed significant differences between the fig varieties (T1 and T2) with respect to fruit weight (g). The Nezhualcóyotl variety exhibited the highest fruit weight (70 g) compared with the Black Mission variety (52 g), when grown in soil under

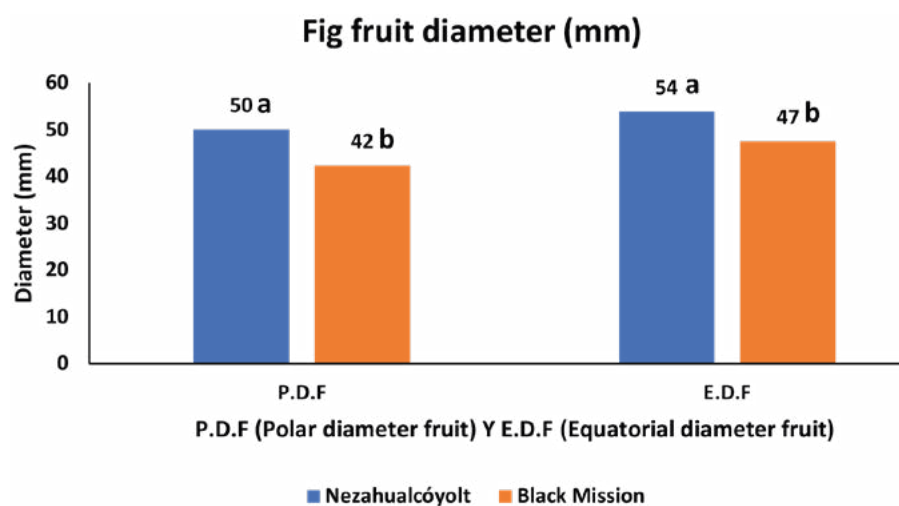


Figure 1. Mean comparison (Tukey, $p \leq 0.05$) of fruit polar diameter (FPD) and fruit equatorial diameter (FED) in fig cultivated under intensive management and greenhouse conditions during the 2024-2025 growing cycle. Identical letters indicate no statistically significant differences.

greenhouse conditions with eight stems per plant (Figure 2). Fruit weight in both varieties was higher than that reported by Darjazi (2011), who found fruit weights ranging from 8.0 to 43.5 g.

Yield (t ha^{-1})

Statistical analysis revealed significant differences between the varieties under study (T1 and T2) with respect to yield (t ha^{-1}). The highest fresh fruit yield obtained was 62 t ha^{-1} for the Nezahualc6yotl variety, whereas the Black Mission variety produced 46 t ha^{-1} (Figure 3). These yields exceeded those reported by Nienow *et al.* (2006) in southern Brazil, who, using the Roxo de Valinhos variety at a spacing of 1.5 m between plants and 1.90 m between rows, and managing 8 to 12 stems per plant, obtained yields ranging from 41 to 43 t ha^{-1} .

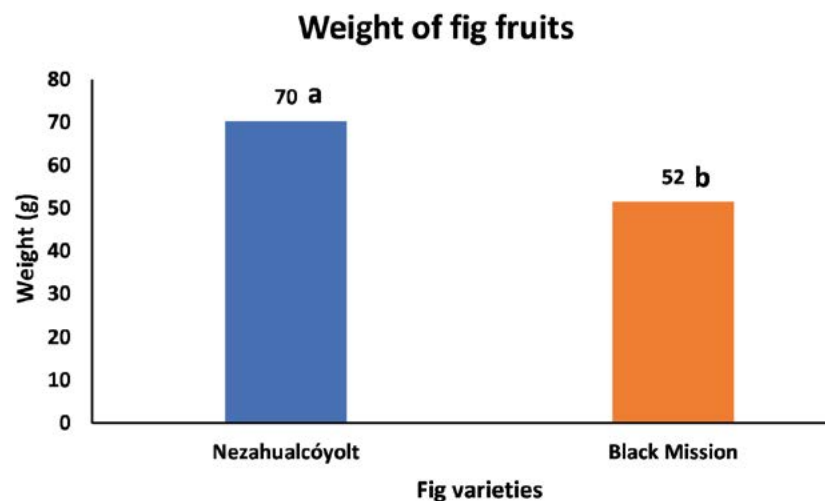


Figure 2. Mean comparison (Tukey, $p \leq 0.05$) of fruit weight (g) in fig cultivated under greenhouse conditions during the 2024-2025 growing cycle. Identical letters indicate no statistically significant differences.

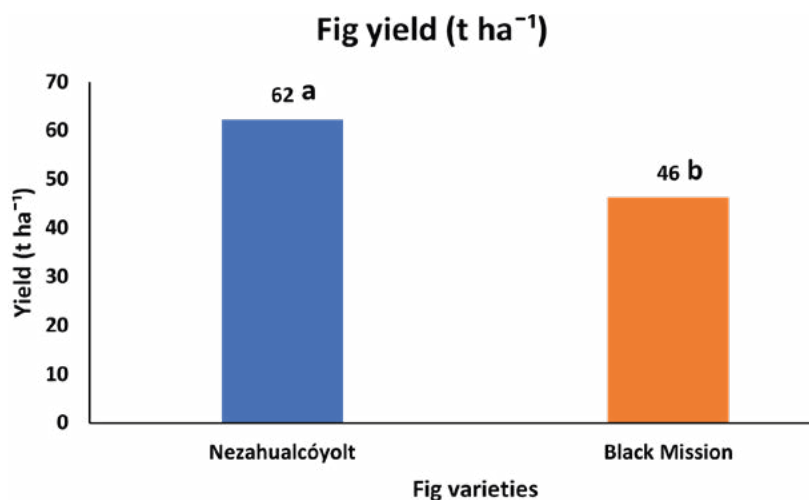


Figure 3. Mean comparison (Tukey, $p \leq 0.05$) of fig yield (t ha^{-1}) under greenhouse conditions during the 2024-2025 growing cycle. Identical letters indicate no statistically significant differences.

°Brix (%)

No significant differences were observed between treatments with respect to total soluble solids (°Brix).

CONCLUSIONS

The Nezahualcóyotl fig variety exhibited the greatest polar diameter, equatorial diameter, fruit weight, and yield under greenhouse conditions. No differences were observed between the two fig varieties with respect to fruit total soluble solids (°Brix).

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