






# Vermicompost doses on nutraceutical properties and yield of *Physalis ixocarpa* Brot. Ex. Hornem

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## ABSTRACT

**Objective:** To evaluate different doses of vermicompost on the nutraceutical properties and yield of tomatillo (*Physalis ixocarpa* Brot. Ex. Hornem.) under field conditions

**Design/methodology/approach:** A randomized block experimental design was used with 4 treatments: T1 Synthetic fertilization (FS) (YaraMila Complex), T2 Vermicompost 50 g per plant (T2 50 g L), T3 Vermicompost 100 g L) and T4 Vermicompost 200 g L, with 20 replicates and 3 blocks per treatment with a total of 240 experimental units.

**Results:** Statistical analysis showed significant differences between treatments ( $P \leq 0.05$ ) for all evaluated variables, where a trend was observed that the best treatments were the applications of vermicompost of 100 and 200 gs per plant (T3 100 g L and T4 200 g L) for nutraceutical variables and a yield per plant of 8 kg.

**Limitations on study/implications:** include the contribution of vermicompost in the soil under study.

**Findings/conclusions:** The best treatments were doses of 100 and 200 gs of vermicompost per plant, which improves some nutraceutical characteristics of the tomatillo crop.

**Keywords:** tomatillo, acidity, °brix, polyphenols, DPPH.

**Citation:** Alemán-Chávez, I., Bautista-Cruz, A. A., Aquino-Bolaños, E. N., Alba-Jiménez, J. E., Moreno-Cortés, M. L., & Lara-Capistrán, L. (2026). Vermicompost doses on nutraceutical properties and yield of *Physalis ixocarpa* Brot. Ex. Hornem. *Agro Productividad*. <https://doi.org/10.32854/hrvw2q18>

**Academic Editor:** Jorge Cadena Iñiguez

**Associate Editor:** Dra. Lucero del Mar Ruiz Posadas

**Guest Editor:** Juan Francisco Aguirre Medina

**Received:** XXXX XX, 2025.

**Accepted:** March 14, 2026.

**Published on-line:** May XX, 2026.

*Agro Productividad*, 19(4). April. 2026. pp: 201-207.

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## INTRODUCTION

In Mexico, one of the commercially important agricultural crops is the tomatillo (*Physalis ixocarpa*). In 2024, 694,327 tons were harvested from 37,504 hectares, resulting in a national average yield of 18.5 tons per hectare (SIAP, 2024). Sinaloa led the way with 136,593 tons produced, representing 19.7% of the national total. It was followed by Zacatecas with 79,953 tons (11.5%), Jalisco with 73,978 tons (10.7%), Puebla with 58,989 tons (8.5%), and Michoacán with 50,183 tons (7.2%) (SIEGSIN, 2025).



Due to their high demand in the food industry, tomatoes regulate and improve digestion. Furthermore, they are a source of bioactive substances that neutralize free radicals and slow down the aging process (Majkowska-Gadomska *et al.*, 2021). This crop is conventionally produced throughout much of Mexico, using high doses of synthetic chemical fertilizers (Cruz *et al.*, 2017), which represents a source of environmental pollution, leaching, contamination of groundwater and surface water, negative impacts on pH levels, deterioration of soil structure, and damage to microfauna, among other issues (González, 2019).

Therefore, alternatives are being sought to reduce the use of chemical fertilizers, highlighting organic fertilizers, leachates, and the use of vermicompost (Rivadeneira-Manzanilla *et al.*, 2024). The addition of organic fertilizer with chemical fertilization at a 50% ratio equals yields and improves fruit quality in tomatillo (*P. ixocarpa*). It has been observed that the use of vermicompost improves the physicochemical characteristics of the soil, increases yields and fruit quality, and also improves the bioactive compounds in this Solanaceae. Aguiñaga-Bravo *et al.* (2020) report that the addition of organic fertilizer with chemical fertilization at a 50% ratio equals yields and improves fruit quality in tomatillo (*P. ixocarpa*) (Gamero-Vega *et al.*, 2022). However, research is needed to determine the appropriate doses to optimize yields for this crop. Therefore, the objective was to evaluate various doses of vermicompost on the nutraceutical properties and yield of tomatillo (*Physalis ixocarpa* Brot. Ex. Hornem.) under field conditions.

## MATERIALS Y METHODS

### Geographic location of the study area

The crop was established between February and May 2022 on a ranch located in the municipality of Coatepec, Veracruz, Mexico, at the geographic coordinates 19° 29' 36.12" N, 96° 56' 37.41" W, with a land area of 269 m<sup>2</sup> at an altitude of 1255 m above sea level. The soil has a silty loam texture, with a pH of 6.5, 6.6% organic matter, 33% total N, 42 ppm of P, 225 ppm of K, 3198 ppm of Ca, and 408 ppm of Mg. The average temperatures reported for the months of the experiment were 25-40 °C, and rainfall was 95-104.8 mm (CONAGUA, 2025).

### Experimental design and description of treatments

A randomized block experimental design was established with 4 treatments: T1 Synthetic fertilization (FS) (YaraMila Complex), T2 Vermicompost 50 g per plant (T2 50 g V), T3 Vermicompost 100 g V) and T4 Vermicompost 200 g V, these last treatments also incorporated fertilizer at 50% with 20 replications and 3 blocks per treatment with a total of 240 experimental units.

### Crop management

Green tomato (*Physalis ixocarpa*) seedlings of the Querétaro variety, from the Harris Moran company, were used, with an approximate height of 10 cm. These were transplanted into beds previously disinfected with the disinfectant FULL-GRO, applied at a dose of

9.75 mL·L<sup>-1</sup> of water. Simultaneously, 80-gauge plastic mulch was placed, and a drip irrigation system was installed.

### Organic fertilization

During transplanting, 0, 50, 100 and 200 g of vermicompost based on horse pulp were applied per plant, which had the following characteristics: 84% organic matter, pH of 7.400, 0.250% phosphorus (P), 3.997% nitrogen (N), 2.140% potassium (K), 1.720% calcium (Ca), 0.800% magnesium (Mg), a C/N ratio of 12.219, 10.595% fulvic acids and 15.105% humic acids.

### Fertilization and pest control

Fertilization of the fertilized treatment (T1Fs) was carried out eight days after transplanting with YaraMila Complex (12-11-18 EM), at a rate of 50 g per plant. The other treatments received only 25 g per plant of the same fertilizer. During the crop cycle, three applications of Bayfolan Forte were made to all treatments, using a dose of 1 mL·L<sup>-1</sup>. Monochromatic blue and yellow traps were used for pest monitoring. Pest control was carried out using applications of neem extracts, Biopest Max, Micro Soil Control, and copper oxychloride, all at a dose of 1 g·L<sup>-1</sup>.

### Variables evaluated

56 days after transplanting, the following were evaluated: fruit weight per plant (g), polar (mm) and equatorial diameter of the fruit (mm), total soluble solids (TSS) expressed in °Brix with a digital refractometer, pH with a Redemon model potentiometer, titratable acidity, total polyphenols (mg GAE 100 g<sup>-1</sup> t.f.), with the method of Singleton and Rossi (1965), antioxidant activity by DPPH was carried out by the 2,2-diphenyl-1-picrylhydrazyl (DPPH) method described by Brand-Williams *et al.* (1995) and total yield per plant (kg) amount of 5 harvests.

### Statistical analysis

Normality tests were performed and, after verifying the statistical reliability of the data, they were analyzed using an ANOVA and Tukey's mean comparison with a significance level of 5% ( $\alpha=0.05$ ) of the STATISTICA software (Version 8.0.360.0 StatSoft Inc., Tulsa, USA) for Windows (StatSoft Inc, 2007).

## RESULTS AND DISCUSSION

Statistical analysis revealed significant differences between treatments ( $P\leq 0.05$ ) for all variables evaluated, showing a trend towards the best treatments being the applications of vermicompost at 100 and 200 g per plant<sup>-1</sup> (T3 100 g V and T4 200 g V) (Table 1). A greater fruit weight (36.8 g) was observed in the treatments with high doses of vermicompost (T3 100 g L<sup>-1</sup> and T4 200 g V); similar values were reported by Singh *et al.* (2014) with 29.33-37.67 g.

Similarly, for the polar and equatorial diameter (43-36 mm), similar data were reported by Ramírez-Godina *et al.* (2013) in the same crop (4.65-3.99 cm). A higher amount of total

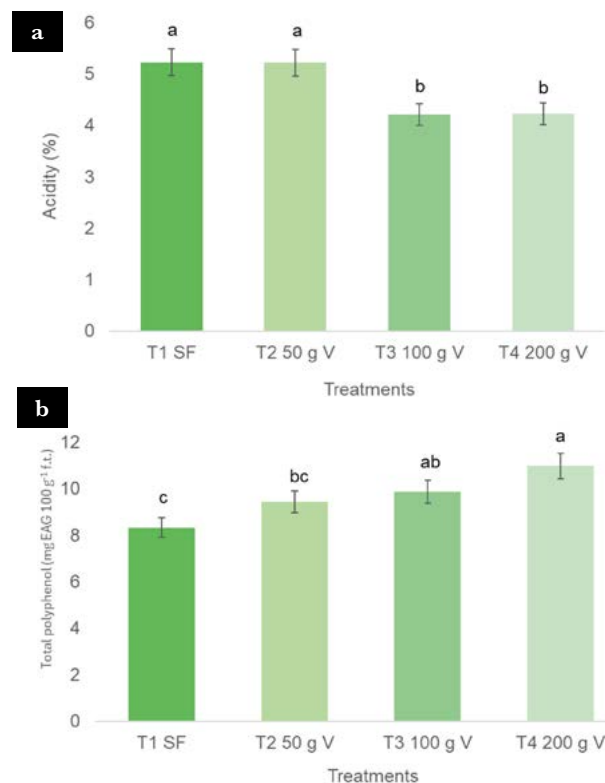
**Table 1.** Statistical analysis for growth variables.

Treatments	Weight of fruit (g)	Polar diameter of the fruit (mm)	Equatorial diameter of the fruit (mm)	TSS (°Brix)	pH
T1 SF	25.9±1.3c	40.0±1.1b	32.1±1.2b	4.55±1.1b	4.5±1.2b
T2 50 g V	26.8±1.2c	40.0±1.2b	32.3±1.4b	4.58±1.2b	4.5±1.3b
T3 100 g V	33.8±1.4b	43.0±1.1a	35.0±1.3a	5.67±1.1a	5.2±1.2a
T4 200 g V	36.8±1.1a	43.0±1.4a	36.0±1.5a	5.68±1.3a	5.5±1.1a

Values with the same letter, within columns, are statistically equal to each other (Tukey,  $P \leq 0.05$ ).  $\pm$  Standard deviation.

soluble solids was also observed in the treatments with the highest amount of vermicompost (5.67-5.68 °Brix). These results contradict those reported by Aguiñaga-Bravo *et al.* (2020) (6-7 °Brix), where synthetic fertilization influenced the finding of sweeter fruits. Regarding fruit pH, the treatments with SF and lower amounts of vermicompost were more acidic, unlike the higher doses of vermicompost, which were less acidic. The same trend was observed in the percentage of titratable acidity (5.2%) (Figure 1a). These results may be related to the concentration of salts present in synthetic fertilizer.

For the nutraceutical variables of the crop, significant differences were observed between the treatments evaluated ( $P \leq 0.05$ ). For total polyphenols, the fruits with vermicompost at a dose of 300 g per plant were higher at 10.98 mg GAE in 100 g<sup>-1</sup> t.f. These results are



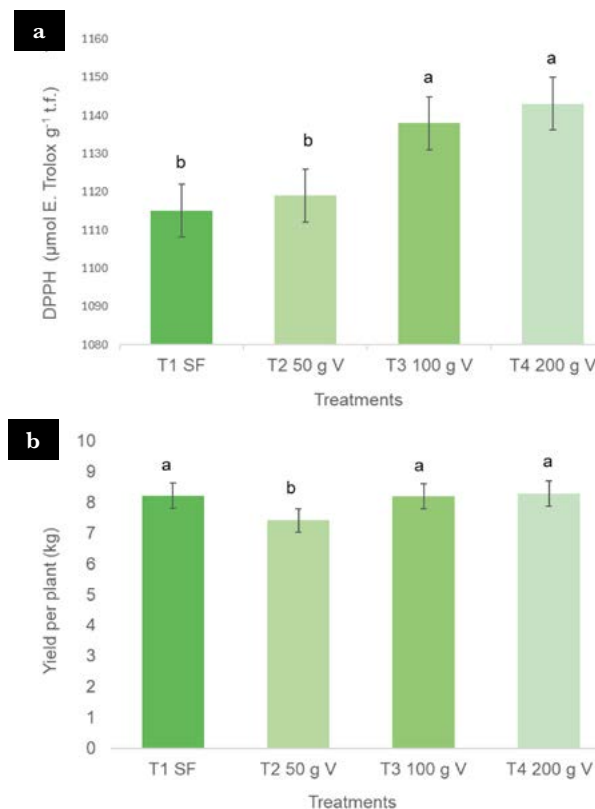
**Figure 1.** Nutraceutical properties of tomato fruits a) acidity, b) total polyphenols. Equal letters on the same bar are statistically equal to each other (Tukey,  $P \leq 0.05$ ).  $\pm$  Standard deviation.

similar to those reported by Majkowska-Gadomska *et al.* (2021), who reported 10.15 mg of total polyphenols in fruits from treatments with mulch.

For antioxidant activity, the same trend was observed as for total polyphenols, where the highest dose showed the highest content in tomato fruits: 1143  $\mu\text{mol ETrolox } 100 \text{ g}^{-1}$  t.f. (Figure 2a). These results were higher than those reported by Aguiñaga-Bravo *et al.* (2020), who reported between 1119 and 1123  $\mu\text{mol ETrolox } 100 \text{ g}^{-1}$  t.f. in treatments with synthetic fertilization and combined with organic fertilizers.

For yield per plant, it was observed that the treatments with vermicompost at high doses of 100 and 200 g per plant were similar to the fertilized treatment (Figure 2b), with an average of 8 kg per plant, which is higher than those reported by Aguiñaga-Bravo *et al.* (2020) for this same crop and that reported by Ramos-López *et al.* (2018) who report yields of 4.84  $\text{kg m}^{-2}$  and 2.10  $\text{kg m}^{-2}$  of the cv. Rendidora under greenhouse and field conditions. The results obtained in this research may be related to the physical, chemical, and microbiological properties present in vermicompost, as has already been mentioned in horticultural crops (Rivadeneira-Manzanilla *et al.*, 2024).

They are also related to the rich organic matter content of the soil where the crop was established, since each year the crop is left fallow for a cycle, allowing legumes to be incorporated into the soil. These results are consistent with those reported by Quispe *et al.* (2021) in maize cultivation, where yields increased with the incorporation of organic fertilizers.



**Figure 2.** DPPH antioxidant activity a) and yield per plant (kg) b). Identical letters on the same bar are statistically equal to each other (Tukey,  $P \leq 0.05$ ).  $\pm$  Standard deviation.

## CONCLUSIONS

According to the results, the statistical analysis showed that the best treatments were the doses of 100 and 200 g of vermicompost per plant. Therefore, the localized application of 100 g of horse manure vermicompost per plant could be recommended, as this improves some of the nutraceutical characteristics of tomatillo cultivation.

## ACKNOWLEDGMENTS

The authors thank the students of the course II. Design of agroproductive systems, the laboratory staff of the Center for Research and Development in Food (CIDEA-UV), as well as Dra. Teresita de Jesús May Mora for the support in the Soil Laboratory of the Faculty of Agricultural Sciences of the Veracruzana University.

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