

Yield and economic analysis of three chili hybrids (*Capsicum annuum*, L.) in cuatro caminos, san gabriel, jalisco, Mexico

Abstract

The purpose was to analyze the performance, investment and profitability of three chili hybrids of the Company “González Produce RESE SPR DE RL”, in Cuatro Caminos, San Gabriel, Jalisco, Mexico. The hybrids evaluated were: Caloro, Serrano – Platino and Jalapeño – Valquiria. The experimental unit was one hectare per hybrid, with fertigation and mulching. The beds were 1.20 m wide, with double-row planting and 0.30 m of separation between plants. The yield (t ha⁻¹) was calculated with the number of harpillas harvested, multiplied by 30 kg for Caloro and Jalapeño, and 25 kg for Serrano. Economic income, cost / benefit ratio, equilibrium point and invested weight gain were estimated. Chile Serrano registered 1,658 arpillas ha⁻¹, equivalent to 41 t ha⁻¹, surpassed Caloro and Jalapeño by 8.39 and 36.0%, respectively. Caloro’s production cost was \$ 556,347.00 ha⁻¹, 34 and 51% higher than Serrano and Jalapeño. The income obtained from the sale of Serrano pepper was \$ 969,050.00, 3.9 and 31% higher than Caloro and Jalapeño. The C / B ratio for Serrano was 1.78; Caloro, 1.67 and Jalapeño, 1.21. The equilibrium point was reached for Caloro at 7.08 t ha⁻¹, Serrano – Platino and Jalapeño –Valquiria with 10.21 and 20.72 t ha⁻¹, respectively.

Keywords: chili yield, caloro, jalapeño and serrano, economic analysis, breakeven

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Introduction

The chili (*Capsicum annuum* L.) is cultivated worldwide in an area of 1.7 million hectares, with a production of 29,939,029 t.¹ The chili producing countries worldwide are: China, followed by Mexico, Turkey, the United States of America, Spain and Indonesia and the main importers are: United States of North America, Germany, United Kingdom, France, Holland and Canada.²

In Mexico, an area of 28,547 ha is cultivated, with a production of 804,259 t and an average yield of 37,044 t ha⁻¹. The producing states in order of importance are: Sinaloa with 636,990 t, Sonora 61,841 t, Baja California sur 24,655 t, Jalisco 22,331 t and Tamaulipas with 13,606 t.³ The state of Jalisco occupies the fifth place as a producer of chili, with an area dedicated to cultivation of 4,300 ha, produces 100,000 t year⁻¹, with average yields between 45 and 85 t ha⁻¹, which represents 4.3% of the national production, contributes 800 million pesos, which corresponds to 5.3% of the value of national production.⁴ In the state of Jalisco, 52 Chilean producing municipalities are reported, they stand out by production volume: Mascota, San Gabriel, Cihuatlán, Etzatlán and Tomatlán, together they contribute 55% of the total produced in the State.

In Mexico, different species and varieties of chili peppers are grown,⁵ from broad, jalapeños, serranos (green), poblano, mirasol (known as dry guajillo), bell or bell pepper, anaheim and caloro.⁶ The chili pepper is consumed fresh within the country and is also exported to the United States.⁶ In the state of Jalisco a variety of diversity of species, among them, serranos and jalapeños stand out.

In the production system of each hybrid under study, a strict control of each action carried out was carried out in the log, in accordance with a schedule of fertilization dates, and control of pests and diseases. The cultivation of chili is a high investment, for this reason, the company records all expenses: labor, use of vehicles, equipment to deduct from sales income and know the benefits. For them, the cost-benefit was estimated, which is directly related to

the decision theory to determine the viability and relevance of the project. Every company has the purpose of winning, which requires the evaluation of the yields per unit of surface.⁷ The expenses of each action are converted into production costs of the production process. The purpose of the company is to determine the highest profitability of the agroecosystem so that it is competitive and sustainable.⁷

The gastronomic industry uses chili to flavor a variety of foods.⁸ In medicine, it is used as an antioxidant to reduce the hardening of the arteries and capsaicin is anti-inflammatory.⁵

Chili peppers are sources of vitamin A, C, B6, as well as K and Mg.⁹ Chile Serrano contains low protein content (2%), low in fat (0.4%) and soluble fibers based on pectins and amylopectins with 1.5%. Each 100 g of serrano pepper contains minerals such as: Ca (12 mg), P (36 mg), Fe (0.4 mg), K (311 mg), Mg (21 mg), Na (7 mg) and Zn (240 µg); Vitamins A (30.5 µg), Alpha Carotenes (18 µg), Beta Carotenes (534 µg), Vitamin C (65 mg) and Vitamin B complex: Thiamine B1 (140 µg), Riboflavin (B2, 50 µg) and Niacin (B3, 1300 µg).¹⁰

The company “González Produce RESE SPR DE RL” is dedicated to the cultivation of chili. In spring-summer of 2017, he planted three hybrids of economic and social importance, among them: caloro, jalapeño and serrano (Figure 1), these cultivars are of high investment and were cultivated in the open sky, in conditions that face uncertainty due to the limiting factors in production. The company was raised as an unknown, How to achieve maximum yields in open sky conditions? In soils of medium potential? With the presence of pests and diseases? that severely affect the vegetative development, yield and product quality. For this, the company registered in the log each action, such as the inputs used during the production process, vehicles and equipment, and labor, so the performance was determined based on the number of harpillas harvested from each hybrid, the depreciation of vehicles and equipment used in agricultural activities, the cost / benefit and equilibrium point based on criteria of cost of production and income from the sale of the product.⁷



Figure 1 Chili hybrids: a) Caloro, b) Serrano and c) Jalapeño grown in Cuatro Caminos, San Gregorio, Jalisco.

In agroecosystems cultivated with chili peppers, they are labor-intensive throughout the production system, only at harvest it requires 120 to 200 wages per hectare¹¹ The company projected profit for each peso invested and profitability.⁷

The document is composed of a summary, abstract, introduction, objective, methodology, results and discussion, conclusion and bibliography.

Objective

The objective of this study was to evaluate the yield of three varieties of chili, estimate production costs, depreciation of vehicles and equipment, and compare the economic income for the company “GONZALEZ PRODUCE RESE SPR DE RL” of Cuatro Caminos, San Gabriel, Jalisco Mexico.

Methodology

The company “GONZALEZ PRODUCE RESE SPR DE RL”, is located in Cuatro Caminos, Municipality of San Gabriel, Jalisco, at the geographic coordinates: 19°41'32.36" Lat N and 103°47'51.42" Long W. Average temperature annual is 21.3°C, with average annual rainfall of 741.6 mm and soils of the Group of the Haplic Feozems.¹²

The soil was prepared with agricultural machinery, it was a fallow to incorporate the residues of the previous cycle, harrowing and furrowing and the plowed soil was exposed to solarization to combat some larvae of soil pests.

The experimental unit was one hectare, the crop was established in the PV-2017 cycle. After solarization, the beds were drawn at 1.20 m and with the quilting machine the irrigation strip and the plastic were placed, taking care that the strip emitters were facing upwards, the black color of the plastic facing downwards and the white facing upwards. The fertigation strips were placed in a double row, 0.30 m apart, leaving 0.90 m of street; the band was 16 mm in diameter. The plastic of the mulch was perforated at every 0.30 m, making 5 cm diameter circles for transplantation. The hybrids evaluated were: Caloro, Serrano and Jalapeño (Figure 1). The seeds were germinated in a greenhouse (for protection by evasion) and when the plants were 0.15 m tall they were transplanted. Before transplanting, the roots of the Chili plants were submerged for five minutes in a solution with fungi, to protect against diseases originating in the soil. The population density was 55,555 plants ha⁻¹. Irrigation was applied every 5 days for 30 minutes. The water tank had a capacity of 10,000 L, where the water-soluble fertilizer, fungicides, nematicides and rooting agents were mixed.

The sources and doses of the fertilizers applied by phenological stage are indicated below: from week 1 to 4 (transplant-flowering) they were 15 kg Phosphonitrate + 15 kg Potassium Nitrate; from week 5 to 10 (flowering-fruiting phase) with 20 kg of Phosphonitrate + 15 kg of Calcium Nitrate + 20 kg of Potassium Nitrate; from week 11 to 16 (fruiting-harvest) with 25 kg Phosphonitrate + 25 kg Calcium Nitrate + 25 kg Potassium Nitrate; from week 17 to 24 (harvest) with 50 kg Calcium Nitrate + 25 kg Potassium Nitrate.

Pests were controlled with: Durivo 350 SC (Thiamethoxam + chlorantraniliprole), Confidor 300 SC (Imadacloprid), Clutch (Clotianidin), Movento 150 (spirotetramat), Regent 4 SC, Oregon 60 SC (Abamectin); and diseases with the following chemicals: Agry-Gent Plus 800 (Oxytetracycline), Cupravit (Copper Oxychloride), Terramycin (Oxytetracycline), Defense GR (Foliar Nutrient).

The chili yield per hectare was calculated with the number of harpillas harvested, the conversion factor of 30 kg was used for Caloro and jalapeño, and 25 kg for serrano to transform from arpillas to kg ha⁻¹. With the values obtained, it was estimated: cost/benefit ratio, the equilibrium point and the profit per invested weight, parameters of interest for the company in decision-making.

The financial analysis considered the depreciation expenses of the equipment used during the production cycle, having considered the cost and useful life per year, and for the number of days used during the production cycle (180 days). The yield comparison was with analysis of variance.

Results and discussion

The depreciation of vehicles and equipment was estimated on an individual basis. The vehicle cost \$ 300,000.00, a useful life of 10 years was considered, with a 10% annual depreciation, resulting in a depreciation of \$ 30,000.00, which distributed over 365 days, a daily depreciation of \$ 82.19 was obtained. The production cycle from preparation of the land to removal of all materials used in the production process was 180 days, therefore, the estimated depreciation was \$ 14,794.20 for 180 days. The gasoline pump had a cost of \$ 6,000.00 and a useful life of 3 years; the depreciation was \$ 2,000 per year, \$ 5.00 per day, for the 180-day production cycle it was \$ 986.00. It is concluded that the higher cost of the equipment had lower depreciation than the lower cost equipment due to its useful life.

The yields per hectare were: 855 burlap for caloro (25,650 kg ha⁻¹), 1658 burlap for serrano (41,450 kg ha⁻¹) and 1252 burlap (37,560 kg ha⁻¹) for jalapeño. The yield obtained from serrano in the PV-2017 cycle in Cuatro Caminos, San Gabriel, Jalisco, Mexico, was 46.6% higher than that reported by SIAP (2017) for the same cultivar in the state of Sinaloa with 22.14 t ha⁻¹; in jalapeño, the superiority in yield was 63% and in caloric 73% (SIAP, 2017). The yield registered in Serrano surpassed Caloro and Jalapeño by 38.12 and 9.38%, respectively. The analysis of variance had no significance, it resulted in R² = 0.3, which indicates that 30% of the variability of the yield could be attributed to the hybrid vigor of the seeds used, to chemical fertilization and to the control of pests and diseases, therefore reason, the chili hybrids studied had similar responses.

The prices of chili, as with most agricultural products, are a function of the demand and supply in the market and the harvest season, that is, the first harvests have a higher value in the market, on average the prices were: for serrano of \$ 12.00, caloric \$ 32.00 and jalapeño of \$ 29.00. It is concluded that the sale prices for the PV-2017 cycle were higher than for June 2019. The revenues were: for caloric

with \$ 930,960.00, serrano with \$ 969,050.00, and jalapeño with \$ 659,580.00. Higher economic income was obtained with the serrano-platinum hybrid, which was 3.93 and 31.94% higher than the income obtained with caloró-Becán and jalapeño-valkyrie, respectively.

The cost/benefit relationship is presented in Table 1, observing that the three hybrids were profitable, because the resulting value of the relationship was higher than 1. Even so, the highest profitability was registered with the Serrano hybrid, which exceeded 0.11 to heat and with 0.57 to the jalapeño, that is, in 6.17 and 32.02% respectively. The data of the cultivar caloró are interesting, which produced 15,800 t ha⁻¹ less than the serrano hybrid, but with economic income and a cost / benefit ratio of reduced margin than those obtained with the serrano hybrid. This information is very relevant in the decision-making of the producer, because the cultivation of chili is of high investment, as shown in this study.

Table 1 C/B ratio of hybrids, PV-2017, Cuatro Caminos, San Gabriel, Jalisco, Mexico

Features	Hybrids		
	Caloro	Serrano	Jalapeño
Performance (t ha ⁻¹)	25,650	41,450	37,560
Production cost (\$ ha ⁻¹)	534,351	522,351	520,351
Entry (\$ t ha ⁻¹)	930,960	969,050	659,580
Relationship C/B	1.67	1.78	1.21

The breakeven point was determined with fixed costs, variable costs and total income. The equilibrium point was reached for each hybrid: heat with 4.75 t ha⁻¹, whereas for Serrano and Jalapeño it was 6.83 and 15.13 t ha⁻¹, respectively. This yield is the lower limit, from which the profits for the producer start. The results show that the serrano hybrid was the best genetic material cultivated in the open air, in Cuatro Caminos, San Gabriel, Jalisco.

The net income was obtained from the total income (IT) minus the total cost (CT), with the following formula: IN = IT - CT. Income from caloró hybrids serrano and jalapeño in Cuatro Caminos, San Gabriel, Jalisco, in the PV-2017 cycle, had a production cost of \$ 1,643,041.00 per hectare, with the income of \$ 2,559,590.00 from sales, therefore, the net income (IN) was \$ 916,549.00.

With the Caloro hybrid, the production cost was \$ 534,351.00 and the total income was \$ 930,960.00, therefore, the net income (IN) was \$ 396,609.00.

In the hybrid Serrano there were total expenditures of \$ 522,351.00 and total income of \$ 969,050.00 from sales, therefore, the net income (IN) was \$ 446,699.00.

With the Jalapeño hybrid, total expenditures of \$ 520,351.00 were made and total income of \$ 659,580.00 was obtained, therefore, the net income (IN) was \$ 139,229.00.

Comparing the three hybrids, it is concluded that the serrano surpassed caloró in 11.21% and serrano against jalapeño with 68.83%. Therefore, with the highland-platinum hub, the company had higher profits.

The profit per weight invested (GPI) results by dividing the net income (IN) by the total cost (CT).

Therefore, the gain per weight invested, in the production of chili hybrids in Cuatro Caminos, San Gabriel, Jalisco were: Caloro for \$ 1.00 invested, the gain was \$ 0.74, in Serrano \$ 0.85 and in Jalapeño, \$ 0.26.

Cost/benefit ratio for caloró was 1.67, serrano with 1.78 and jalapeño with 1.21. Therefore, a greater relationship with the mountain was obtained.

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Conclusion

The conclusions based on the analysis and interpretation of the field and office information, it is concluded that: the higher the cost of the vehicle and equipment, the lower the depreciation and vice versa. The serrano pepper had the highest yield, followed by jalapeño and caloró. By income level, the serrano pepper contributed the highest income, followed by caloró and jalapeño. By C / B ratio, it was the serrano pepper with 1.78, then the caloró with 1.67 and jalapeño with 1.21. The equilibrium point was reached with 4.75 t ha⁻¹ for caloró, 6.83 t ha⁻¹ for serrano and 15.13 t ha⁻¹ for jalapeño. The gain obtained per invested weight, for caloró was \$ 0.74, serrano was \$ 0.85 and jalapeño was \$ 0.26. The chili crop is of high investment, due to the equipment and machinery, agrochemical inputs and labor, however, high economic benefits are obtained per unit area.

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None.

Conflicts of interests

No conflicts of interests exist.

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