

Typology of peach producers in Zacatecas, Mexico by attributes of fruit quality

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Abstract

Zacatecas is positioned among the five leading peach producing states in Mexico. The peach is creole, yellow, bonded bone, firm pulp, sexually propagated and cultivated in temporary in $\approx 81\%$ of the cultivated surface; what, highlights the low competitiveness of this crop. However, due to the number of producers dedicated to this crop, it enhances its socioeconomic importance in relation to other fruit trees. If it is intended to understand the characteristics and problems of the production units (UP) that serve as an instrument to optimize the allocation of public resources, and propose strategies that improve the development of agriculture, it is necessary to understand the heterogeneity of producers considering their socio-economic characteristics within the UP. Therefore, this research sought to analyze and segment technically and typologically the peach producers of the state of Zacatecas. The data was collected through a survey of 204 peach producers in Zacatecas, Mexico. The results suggest four types of producers: 1) those who plant peach without objective; 2) those who plant peach at the backyard level; 3) producers where the peach is part of an agricultural production system; and 4) peach business producers. In this last category, $\approx 31\%$ of the producers were found, which could explain, in part, the low competitiveness of the crop with other product systems.

Keywords: *Prunus persica* (L.) Batsch., competitiveness, socioeconomy.

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At the national level, Zacatecas is among the five states with the highest peach production. The peach tree grown in Zacatecas is a bonded, sexually propagated bone creole cultivated mainly under temporary ($\approx 81\%$), these characteristics highlight the socioeconomic importance of this perennial crop (Sánchez *et al.*, 2013a). It is also important to consider the labor demand, which is estimated annually at \approx four million wages, an aspect that temporarily contributes to the local economy, promotes the roots of the producers and minimizes migration (Sánchez *et al.*, 2012).

Also, since 1999 there has been a rebound in annual per capita consumption (2 kg), suggesting a demand for unsatisfied Mexican peaches (Sánchez *et al.*, 2012). However, even though there are elements that reveal the importance of this crop in the country, the reality shows that in Mexico and specifically in Zacatecas, the agricultural policies implemented consider producers as homogeneous subjects, generating remote support and technical assistance programs of reality (Guillem *et al.*, 2015).

Then, the characterization of producers based on management, productive, social and economic variables allows to know the technologies used and the decision making at the production unit level to develop differentiated policies by production system (Betancourt *et al.*, 2005). For example, the typification of producers in the bean-product systems in Zacatecas (Reyes *et al.*, 2009), sheep in the northern highlands of Puebla (Vázquez *et al.*, 2009), maize in Chiapas (Sánchez *et al.*, 2017), guava (Sangerman *et al.*, 2009) and peach (Larqué *et al.*, 2009) in the State of Mexico.

Similarly, the importance of the typology lies in the fact that the programs and actions for sustainable rural development carried out by the Federal Government specify and recognize the socio-economic and cultural heterogeneity of the subjects and, therefore, take into account the different types of producers (Torres, 2013). However, for the peach-system product in Zacatecas there are no studies that have addressed the characterization of producers in this system-product (Escobar and Berdegue 1990).

Therefore, it is necessary to understand the UP and thereby generate an instrument to optimize the allocation of public resources, improve competitiveness and achieve sustained development of the UP. The objective of this research was to analyze and segment technically and typologically the peach producers of the state of Zacatecas. It was considered that this study could contribute to the design of government policies according to the reality of the UPs for the technological transfer and the development of productive projects that contribute to increase the competitiveness of the Zacatecan peach system-product.

The information was collected through a personalized survey of peach producers, conducted between the months of July and August 2013. The competitive and socioeconomic positioning of the peach has remained static over the last five years (SIAP, 2018); therefore, the information was considered valid. The questionnaire, customized, was applied to a sample of 204 peaches of the register of producers registered in the system-peach product of the state of Zacatecas. The sample size was calculated based on the formula of finite populations with a level of significance at 5% ($Z=1.96$) and 6.9% as the maximum level of permissible error (Sánchez *et al.*, 2013b).

The surveys were applied in the following locations (number of producers): Calera (40), Chalchihuites (5), Enrique Estrada (22), Sombrerete (29), Valparaiso (5), Florencia (12), Fresnillo (42), Jerez (41), Miguel Auza (4), Morelos (1), Villa Garcia (2) and Villanueva (1) of the State of Zacatecas.

The questionnaire included 50 closed-type questions, which were previously validated; through, a pilot survey. The variables included in this survey were grouped following the classification of Knowler and Bradshaw (2007) as described below.

Characteristics of the producer. Questions were included such as: age, schooling, household members, access to services, land tenure, seniority as a producer, planted area, schooling, technical assistance, organization, available infrastructure, production cost, income, risk perception, credit or agricultural insurance. Attributes of fruit quality: this section inquired about aspects related to the appreciation of the fruit, such as: external color, aroma, size (diameter or weight), flavor, sugar content (sweetness), skin pigmentation (chapeo), absence of lesions or bumps on the fruit, absence of physiological damage (darkening of pulp, cold damage, oxidation), color of the pulp, type of fruit (nectarine, loose bone, stuck bone), shelf life, harvest time, type of packaging, packing size, price per kg, geographic area where peach is sold (northeast, northwest, center, south, southeast of the Mexican Republic), product brand, identification of origin and individual labeling (Cerda *et al.*, 2011; Carriedo *et al.*, 2014).

These attributes were presented in different constructs that included various items measured on a Likert scale between 0 and 5, where 0 indicates that they are totally in disagreement and 5 totally in agreement with the presented statements. The socioeconomic information of the producers was analyzed grouping them based on the income obtained as peach producers in: a) they did not have information about it; b) received less than 20% of the income from peach production; c) peach income equaled 20% of their total income; and d) those producers that had a higher remuneration of 20% of peach production.

Therefore, based on the socioeconomic characteristics of the producers, the four groups, described above, were redefined, respectively, as: a) without clear production objective; b) backyard; c) agricultural production system; and d) business producers. After standardizing and verifying the multivariate normality of the information on fruit quality attributes, the information of the four groups of producers was analyzed; through the multivariate technique by canonical discriminant (DC, Manly, 1986) with the CANDISC command of the statistical analysis system (Version 9.3, 2002-2010, SAS Institute, Cary, NC, USA).

Differentiation of peach producers according to their socioeconomic characteristics

The first group identified as 'business', concentrated 30.8% of the producers surveyed (63 producers). These had an average age of 56 years and a schooling up to secondary. Half of the producers in this group had some kind of credit and in general, they were producers who have assumed risks in their management.

The producers of this group had a high production and presented a high technological management index, because they had the infrastructure to carry out the necessary activities for an optimal management of the crop Hernández (2007) (Table 1).

Table 1. Average values of the key variables for the different groups of peach producers in Zacatecas, Mexico.

Segments	Business	Subsistence	Producers without objectives	Part of its production system
Age (in years)	56	53	54	54
Schooling (years)	8.5	5	5	5
Number of generations in agriculture	3	3	3	4
Total area (ha)	8.7	4.6	3.8	5.4
Yield (t ha ⁻¹)	3.5	1.6	1	1.9
Production cost (t ha ⁻¹)	23 268.8	9 490.9	10 487.2	15 729.4
Net income (\$ ha ⁻¹)	31 182.8	19 576.7	13 135	17 625
Acceptance of new varieties	Positive	Middle	Negative	Positive
Credit	Yes	Not	Not	Not
Willingness to take risks	Takers	Reluctant	Reluctant	Middle
Infrastructure	High	Low	Low	Middle
Information source used	Commercial establishments technicians	Members of the family	Members of the family	Employees

The previous results coincide with what was found by Flores *et al.* (2018), where he mentions that the use of technologies is associated with other factors, such as cultivated area, tenure and schooling as essential components is for greater profitability. The second group called ‘subsistence producers (backyard)’ represented 13.2% of the sample (27 producers). The members of this group had an average age of 53 years. The age of the producer is determinant in the execution of the agronomic practices and, therefore, in the yield of the crop (Ruiz *et al.*, 2001). In general, they had a low technological index, which was negatively reflected in production in the units and they had never had credit or agricultural insurance.

These producers registered a maximum level of primary education, which according to Vargas *et al.* (2015), it is imperative for the good performance of agricultural activities within the UP (Table 1). The third group called ‘producers without objective’ was the largest group with 38.2% of the sample (78 producers). This group of producers considered peach production as a source of income to recapitalize. They had an average age of 54 years, an elementary school education and had not had credit or agricultural insurance.

These producers were characterized by having the lowest economic income, which limited the acquisition of inputs and infrastructure that would have improved the productive capacity of the UP (Table 1). The fourth group identified as ‘part of their production system’ represented 17.6% of the sample (36 producers). In general, this group had an average age of 54 years, an elementary

school education and they had never had credit or agricultural insurance. The results agree with Vilboa and Díaz (2009), where it indicates that the producers of greater age, low schooling and greater experience, have ingrained knowledge, with respect to the form of production.

Typification of producers by quality attributes of peach

The analysis of the surveys by the DC method indicated that Wilks' lambda multivariate test did not detect significant differences ($F= 1.1$; $p < 0.2855$) between producer groups; however, there was a clear trend of differentiation between types of peach producers (TPD) that merited exploration with the first two canonical functions (FC), which explained 82% of the separation between TPD (Table 2).

Table 2. Standardized canonical coefficients (SCC) and correlation (r) between the original variable and the canonical functions (FV) for the quality attributes of the peach in Zacatecas, Mexico.

Variable	Fruit conditions (FC 1)		Marketing attributes (FC 2)	
	SCC	r	SCC 1	r
External color	0.44	0.23	0.1	0.06
Aroma of the fruit	-0.29	-0.19	0.38	0.25
Size	-0.38	-0.21	-0.1	-0.05
Taste of the fruit	1.08	0.65	-0.39	-0.23
Sugar content	0.21	0.12	0.27	0.16
Pigmentation of the skin	0.67	0.44	-0.02	-0.01
Injuries or beating of the fruit	-1.24	-0.69	-0.75	-0.41
Absence of physiological damage	0.97	0.54	0.23	0.13
Color of the pulp	-0.23	-0.16	-0.03	-0.02
Type of fruit	0.24	0.14	-0.31	-0.18
Life of anaquel	-1.1	-0.66	0.98	0.59
Harvest time	-0.16	-0.11	0.65	0.47
Type of packaging	0.68	0.55	0.51	0.41
Packaging size	-0.053	-0.05	-0.73	-0.72
Price per kilogram	-0.65	-0.46	0.66	0.46
Geographic area	0.28	0.24	-0.37	-0.31
Brand of the product	-0.03	-0.04	-0.15	-0.17
Identification of origin	-0.18	-0.15	-0.044	-0.04
Individual labeling	0.27	0.33	0.17	0.2
Significance ($p > F$)	0.285		0.724	
Vector root	0.18		0.11	
Explained variance (%)	52		30	
Coefficient of determination (%)	15		9	

The first FC (FC 1) was designated as ‘fruit conditions’, because the standardized canonical coefficients (SCC) positive for the external color of the fruit, fruit flavor, pigmentation in the skin, absence of damage and type of packaging, contrasted negatively with injuries or fruit hits and shelf life. The individual contribution of each variable was supported with the correlation between the original variables and the FC 1 (r) (Table 2).

In the second FC (FC 2) the positive SCC for fruit aroma, sugar content, harvest time and price per kilogram, contrasted with the packing size, fruit type and geographical area (Table 2), the individual contribution of each variable was supported with the correlation between the original variables and the FC 2 (r) (Table 2). Therefore, this FC was distinguished as ‘marketing attributes’.

The producers defined as entrepreneurs had controlled the part of producing a quality peach, without physiological damages, or physical injuries, but they were not worried about the shelf life of the fruit, perhaps because it was marketed in terms of hours and therefore, did not require infrastructure for the proper storage of the product. On the other hand, this group prioritized aspects of the fruit requested in the market by both the buyer and the consumer, but gave less importance to the size of packaging, type of fruit and geographic area as important marketing aspects in other fruits (Figure 1) quadrant I.

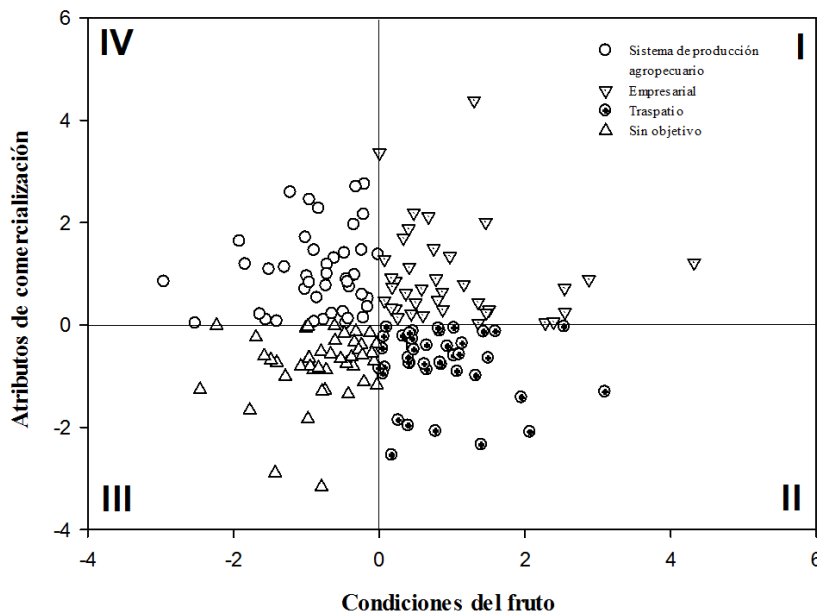


Figure 1. Dispersion of peach producers by its typology based on the two canonical functions.

Therefore, the strategy for these producers are projects aimed at segmenting markets, defining marketing strategies and developing new agro-industrial products. The subsistence producers, as well as the business producers, gave importance to the conditions of the fruit; however, they neglected the marketing attributes, which is due to a rapid commercialization of the fruit to avoid investment in selection and packaging processes (Figure 1) quadrant II.

Therefore, the strategy for this group of producers would be projects aimed at satisfying the needs of the market through the development of infrastructure that allows them to store, select and pack the fruit, and thus add value to the fresh product focused on the search for new customers. that improve the purchase price. The location of the producers without objective suggested that they did not pay attention to any of the aspects evaluated in the survey, but also, it was perceived that they considered that these aspects were controlled and covered satisfactorily (Figure 1) quadrant III; therefore, to move this group of producers from the state of retraction in which it was found, to a sustainable one, it would be necessary to develop a strategy to strengthen technical, mercantile and administrative capacities of these UP.

In contrast, the group of producers who grow this fruit species as part of their agricultural production system, did not worry about the price aspects per kg, packing and type of fruit since this aspect had already been controlled, but it would be recommended to give more attention to the attributes of the fruit (Figure 1) quadrant IV. Then, to guide this group of producers towards a sustainable system (quadrant I), the strategy would be through projects aimed at strengthening the development of technical skills in the aspects of harvest and post-harvest of the fruit. Kyriacou and Roupael (2018) mention that the absence of damage and the homogeneity of the fruit are determining factors of visual quality for the peach.

Conclusions

Based on the study, it was concluded that the peach producers of the state of Zacatecas were grouped into four groups: a) those producers who planted peach without objective; b) those who established peach at the backyard level; c) in producers where the peach was part of an agricultural production system; and d) peach business producers. The characterization detected that approximately 31% of the producers cultivated peach business, this explained, in part, the low competitiveness of the crop before other product systems. To encourage crop productivity, it will be necessary for public policies to be more efficient for this, decision makers will have to consider the heterogeneity between producers and the characteristics that differentiate them.

Additionally, it is important that agriculture be more competitive, therefore, exploring new forms of packaging, type of fruit, development of post-harvest infrastructure and geographic area could strengthen the commercialization of the product and adequately position the Zacatecan creole peach in the national market. Although this research represents the first focus on the characterization of peach producers based on quality attributes, their field of study has been limited to a specific geographic area and their extrapolation must be done with caution.

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