Article

Typology of prickly pear producers in Pinos, Zacatecas

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Abstract

The typification of producers is important for the design, implementation and efficient application of policies, programs and strategies directed to specific groups. The farmers of Pinos, Zacatecas have as their main source of economic income the cultivation of prickly pear. These producers receive government economic support; however, the benefits have not been reflected in the proper development and productivity of their orchards. In order for these supports to be distributed prioritizing the needs of the producers, it was proposed to identify the ways of producing prickly pear based on the age and activities of the producers and the support relationships they establish. For this, a survey was applied to 38 producers in November 2014. Through a multivariate analysis, a correlation of variables and a principal component analysis (CP), groups of producers with distinctive characteristics were determined. Ten types of prickly pear producers were generated (r^2 of 0.69) based on 4 CPs: age and income from prickly pear cultivation are the most determining variables (25% of the variation), yield of prickly pear (17%), income for a complementary activity (15%) and the relationship with partners in production (12%). They identified as priority needs for the development of the "tunera" activity, increase the yield of production, as well as create and strengthen links with local and foreign producers. The classification of producers allows prioritizing and expediting the distribution of support to the most vulnerable groups. It is a priority to design strategies that improve the productivity and quality of the prickly pear and expand its commercialization.

Keywords: *Opuntia ficus-indica*, agricultural production, crop management, multivariate analysis, social relations.

Reception date: December 2018
Acceptance date: February 2019

Introduction

Opuntia ficus-indica is considered the most important agronomic species worldwide for the production of fruit, buds and fodder (Kiesling, 2008). Mexico is the leading producer of prickly pear worldwide, in addition to having the largest area and number of commercial cultivars, although there is a predominance of white pulp cultivars (Sumaya *et al*., 2010). Particularly, in the state of Zacatecas, the municipality of Pinos is the main producer of prickly pear nationwide with a yield of 186 125 t and an area of 13 360 ha (SIAP, 2014). The fruit coming from this municipality is commercialized nationally and internationally; however, not all producers have the same possibility of integrating into the market of this product.

One of the main causes is the low quality of the prickly pear, which is affected, among other things, by the poor management of the plantations. To maintain the quality of the prickly pear, producers must face various problems that are presented year after year. Among them, the incidence of pests and diseases, the low prices of the prickly pear (Márquez *et al*., 2012), the inefficient agronomic management and the deficient commercialization stand out. Additionally, the lack of organization and economic resources (García *et al*., 2004; García *et al*., 2008). They have limitations such as: no technical advice, inefficient government support and high cost in the acquisition of inputs and machinery. These are aspects that impede the development of their crops and cause decline in the production of prickly pear.

Among the actions carried out by some producers to mitigate these limitations is to enroll in government support programs in order to receive additional economic income to pay for the management of their plantations; however, it is not reflected in a quality fruit, nor in its commercialization. Neither in the improvement of their economic income and consequently their level of marginalization is accentuated, particularly for those families that depend on the prickly pear. Producers are mostly interested in goods and services that have a use value, so it is important to generate commercial inputs (Rodríguez *et al*., 2006) that contribute to the development of prickly pear plantations. Likewise, Jelsma *et al*. (2019) mentions that the immersion of innovative techniques and institutional support need to be placed in a wide network within the management of the plantations, to achieve the implementation of good agricultural practices and to intensify the yield.

One way to make these supports more efficient is to know the type of producers that are dedicated to the cultivation of prickly pear, according to Guiomar *et al*. (2018) defining and evaluating the distribution of crops by their particularities allows the formulation of sustainable rural development plans. So these are characterized by presenting distinctive features among them, given the peculiarities of the management of their plantation and their interpersonal relationships that establish between them. To know this distinction, it is pertinent to characterize the typology of producers. This technique allows determining priorities according to each type of producer, as well as identifying the components that should be considered when designing and applying planning strategies in their productive units (Santos *et al*., 2014).

Likewise, the classification based on a multivariate analysis allows greater efficiency in the design of public policies of territorial rural development. In addition, it allows decision makers to focus efforts on the most vulnerable groups or those with particular needs, while streamlining and

streamlining the distribution of resources and providing a basis for timely participation (Marshall *et al*., 2014). A typology of producers can promote the application of differentiated promotion policies through discrimination between large and small farms (Martínez *et al*., 2009).

Considering that there is no differentiation between producers of prickly pear that allows implementing efficient intervention programs and according to their needs, the objective of the study was to identify the types of producers of nopal in Pinos, Zacatecas.

Materials and methods

The present investigation was carried out in the municipality of Pinos, Zacatecas (Figure 1). Which is located in the southeast region of the state of Zacatecas. It belongs to the physiographic province Southern Volcanic Field. It is located at 22º 16' 58" North latitude and 101° 47' and 101° 34' 51'' West longitude, its altitude is 1 900 meters above sea level. The annual average temperature is 16.2 °C and an average annual precipitation of 447.8 mm (CONAGUA, 2014).

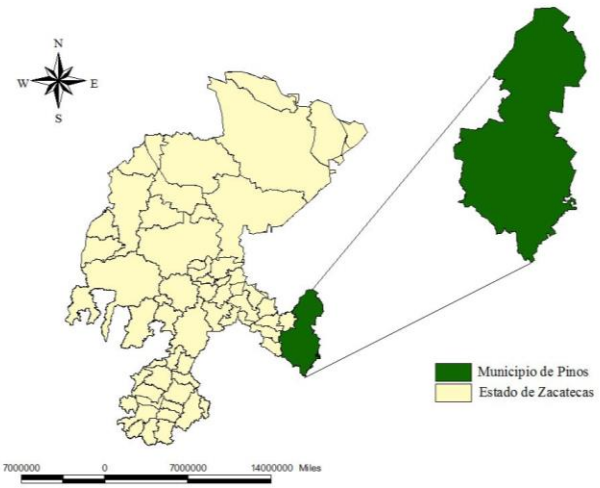

Figure 1. Location of the study area.

To classify the producers of nopal from Pinos, Zacatecas, surveys were applied to 38 producers, which included quantitative and qualitative variables that were transformed numerically for their analysis. Said variables included aspects such as: the age of the producer, the degree of studies, the area planted, the yield of prickly pear, the transmission of technical knowledge, the main and secondary activity and their percentage of respective income, the orientation to the market and the relationships of partner, leader or counselor with local or foreign producers. It analyzed 23 attributes and discarded the 12 variables that presented less than 20% or more 80% of common responses among producers. This decision was based on the fact that they indicated a clear tendency to provide homogeneous information.

Subsequently, a multivariate analysis was performed with the statistical package Statistical Analysis Systems (SAS). The remaining 11 variables were correlated and those with a high dependency on each other were eliminated (Pearson at $r^2 > 0.7$ or < -0.7). The influence of the

characteristics of the producers using main components (CP) with standardized data (zero mean and variance 1) was determined. The dispersion of the 38 producers was then plotted using the two most important components (CP1 and CP2) and groups of producers were formed by similarity in the evaluated characteristics, using the minimum internal variance of the groups as classifier (Ward). The characteristics that defined the formation of groups were identified and the similar characteristics of each group were described, this typification of producers through a multivariate analysis allows to show the complexity of existing conditions in the management of production systems in an area (Köbrich *et al*., 2003). Finally, the groups of producers of prickly pear were united according to each one's needs for action.

Results and discussion

The analysis of the information obtained allowed us to characterize the producers of prickly pear cactus of Pinos, Zacatecas. Regarding the age of the producers, it ranged between 27 and 73 years. This age limit is similar to the age recorded by Venado *et al*. (2015) for producers of nopalito in Tlalnepantla, Morelos (19 to 68 years). On the other hand, Márquez *et al*. (2012) mention that the average age of prickly pear cactus producers in Axapusco, State of Mexico is 60 years, very similar to what was published by Wanjiku *et al*. (2018) with an average age of 54 years. Also, it is highlighted that in the three studies it is appreciated that in the production of prickly pear producers are involved in a greater proportion of older adults, which implies that due to their age they present limitations to perform physical activity when carrying out the management practices required.

The above, makes it difficult to provide the development of skills and abilities in an appropriate manner. Therefore, these producers require production strategies that do not imply a physical effort that damages their integrity. This situation is complicated by the impossibility of hiring external labor. On the other hand, they are people with considerable experience in the cultivation of nopal and transmit knowledge to new generations of young people by inheriting the tradition to their families. This allows continuity to the production of prickly pear and nopal and gives identity to the place (Santos *et al*., 2014), since the identity and the roots of the settlers towards agriculture occur in every crop and place. Pinos is the municipality with the highest production of prickly pear and, therefore, the generational change is an intangible value that must be taken advantage of with policies that support these aging producers.

Regarding the level of schooling, 63% of the producers attended secondary school and 37% primary. In affinity Venado *et al*. (2015), highlight that 47% of high school and 26% of primary school, 17% have upper middle school and 8% higher. Therefore, it can be deduced that the producers of Pinos, Zacatecas had less possibility of studying, possibly because the entry conditions of this area are more precarious and the transfer to the schools is complicated by the distance. The need to strengthen levels of education is clear; however, it must be oriented towards new generations so that the level of education brings them the characteristics of inventiveness, innovation and curiosity to discover new management schemes and improvement of marketing channels, emerging uses around prickly pear, in addition to tools to understand the biological processes linked to the development of prickly pear plantations. According to Prokopy *et al*. (2008) there is a greater probability that people with a broader school education have a positive relationship with the adoption of better agricultural management practices.

As for the cultivated area of prickly pear per producer, it ranges from 0.25 to 57 ha, being higher than that recorded by Venado *et al*. (2015), who mention that each producer of nopal vegetables in Tlalnepantla, Morelos has an average of 5.5 ha cultivated, a similar area of prickly pear was obtained by García *et al*. (2004). Likewise, García *et al*. (2008) reports 2.8 ha of prickly pear per producer for the state of San Luis Potosí. Riojas and Fuentes (2006), highlight that producers who obtain larger volumes are more likely to integrate into the international market. In relation to the yield of prickly pear it is from 1.8 to 60 t ha^{-1}, compared to the 6.1 t ha^{-1} average reported by García *et al*. (2004) in the same study area. Given the small area available, it is important and necessary to organize the producers and design and apply management strategies that standardize the product and achieve a differentiation of it, as well as increasing the yield and quality of the prickly pear. Suárez (2015) in the application of his intervention model that implied improvement actions focused on the transfer of technology, training and promotion of innovative practices, which resulted in a 45% increase in production volume and income. 37% economic So it is essential to devise and apply transformative strategies according to each type of producer.

It is important to mention that 45% of the prickly pear producers of the studied community showed a strong rootedness towards the production of this crop and obtain 100% of their income for said activity. This represented a positive aspect in the organization and local cooperation to make the prickly pear a solid source of income. The interest farmers have in continuing cultivation is beneficial, especially considering that those producers with a strong occupational identity are more flexible to change due to their adaptive capacity and may be less vulnerable to unforeseen situations (Marshall *et al*., 2014). In this regard, Checa and Velázquez (2014) point out that the historical context of the social relations of a given site strengthens the capacity and disposition of the work as a whole. One way to encourage these relationships is through collective actions that allow villagers to maintain their identity and expand their market. They can also be fortified by plans, by common projects and by the unification of criteria about the future of nopal production in the community (Ramos, 2014), especially considering that, in Pinos, Zacatecas, the cultivation of prickly pear is an activity very ingrained, although they do not completely depend on this business.

In relation to the productive activities of the farmers, in addition to devoting themselves to the prickly pear, they are also farmers, laborers, emigrants or merchants, which gives them between 20 and 50% of their economic income. There are some producers who do not consider agriculture as their first source of income (Chikowo *et al*., 2014). Pine producers have complementary activities such as livestock, in addition to receiving financial support from remittances sent by their families (García *et al*., 2004). However, the fact of having additional activities could result in the loss of knowledge and tradition of the cultivation of prickly pear cactus in the region.

The plurality of activities occurs in those places where agricultural activities have lost centrality and are no longer the only source of income for rural producers (Santos *et al*., 2014). This reflects that the interest in carrying out activities related to the field is being lost little by little, together with the insufficient and inopportune economic and organizational support that ensures the profitability of agricultural systems. Another aspect to consider is that in the search for alternative sources of sustenance to support their families, they neglect their orchards. The technical

limitations of maintenance of plots with prickly pear have caused the gradual abandonment of orchards (Márquez *et al*., 2012). These include the inadequate management of the orchards, the presence of pests and diseases, the low quality of prickly pear, the low sale prices and the low profitability of the crop.

The producers of prickly pear are dedicated to the sale or self-consumption of the fruit, without adding value as a semi-finished product for sale or transformation into jams, sweets or other co-products. However, the tuna has functional properties, which places it on the market with competitive advantages over other products, giving opportunities for rural development, so improving the quality, the production process and agricultural practices will allow an optimum use (Sumaya-Martínez *et al*., 2010). The majority of producers allocate their production for local sale, to intermediaries and very few commercialize it to the United States of America. This reflects the difference in market opportunities due to the fact that they do not meet fruit quality standards and only some have the opportunity and possibility to enter the national and international market. The problem of commercialization not only involves prickly pear cactus producers, but also other crops (Santos *et al*., 2014). This limited marketing is caused by an insufficient market, coupled with the fact that it is a temporary fruit and its price is variable. A situation that occurs in San Luis Potosí with prickly pear producers is that they only sell 40% of their production (García *et al*., 2008).

The majority of producers are related to local producers (67%), in relationships as a leader (a role model), a counselor (search for information related to production) or a partner (need for financial support), 24% do not establish a relationship some are considered as producers who work individually, 8% relate only to foreign producers (outside their own community) and the remaining 1% of producers deal with foreign and local producers. These production relationships are given by conversations with experienced farmers or family members who are engaged in this activity (Riojas and Fuentes, 2006) or by specific recommendations (pests and diseases) from other farmers and sellers of agrochemicals (Márquez *et al*., 2012). Not all producers are exposed to information, there is a variation and randomness of communication between producers (Prokopy *et al*., 2008).

These are very local and spontaneous relationships, given that there may be little interaction and little cooperation between producers due to the existing competition. Some relationships become closer reaching compadrazgo relationships (Ramos, 2014). The lack of trust and organization does not allow a satisfactory development for the inhabitants of Pinos, Zacatecas, since 18% of the producers work individually, 10% with foreign producers and 72% with local producers; however, their relationships are not extensive, since they always work with the same colleagues. Due to the above, it is necessary to establish communication networks and the development of trust between producers and research groups that allow and provide social learning and new experiences that could lead to action commitments in the production farms (Wilmer *et al*., 2017).

In order to differentiate groups of prickly pear cactus producers by similarity of their characteristics in the production form, a multivariate analysis was carried out. This method allowed us to identify distinctive features that form groups of producers with similar characteristics. Initially, 23 variables were analyzed, of which 12 were eliminated due to the homogeneity of their responses. A very high correlation was identified between the producers to whom it requests advice and the producers

with whom it is associated (0.802), which implies that the producer of prickly pear goes to the same leaders to seek advice. A dependency was identified between the economic income per prickly pear and the economic income for other activities, these variables were identified as mutually exclusive (-0.848) so they were no longer analyzed. Subsequently, a principal component analysis (CP) was carried out with nine variables.

This method allowed the determination of four CPs with a variance of 0.695 and a total of five variables with the greatest impact (Table 1). The first main component is determined by the age of the producer and the income from the production of prickly pear (25% variance explained). The second component is related to the yield of prickly pear produced by the producers (17% of variance explained). The third component is determined by the economic orientation of the complementary activities of the producer that generate income (15% of the variance). The fourth component is defined by the association with other prickly pear producers, whether local or foreign (12%).

Table 1. Analysis of the main components of 38 producers of prickly pear cactus and nine variables, in the municipality of Pinos, Zacatecas.

Number of variables	Variance	Accumulated variance	Equation
2	0.2534	0.2534	CP1= - 0.454 age of the producer - 0.447 percentage of economic income by production of tunera
1	0.1734	0.4267	CP2= 0.548 prickly pear yield
1	0.1496	0.5764	CP3= 0.564 secondary economic activity
1	0.1187	0.6951	CP4= 0.636 relationship with partners

In a study conducted by Dalogly *et al*. (2014) defined three types of producers with characteristics similar to the present study in which the main variable of separation of groups was the income from agricultural production and agriculture as their primary occupation. He mentions that traditional producers (low income from 100% of the crop) have little interest in the application of new management practices, compared to producers whose income also depends on other activities and those who have gross annual sales of agriculture. Which could be considered to be because of the low monetary capacity to introduce new practices that generate extra expenses. Therefore, producers with greater economic acquisition have greater openness in the adoption of optimal techniques and processes applied to agriculture. Due to the above, the government's contribution through support programs and affiliation in cooperatives between internal and external producers to the locality is indispensable.

The conglomerate analysis allowed the formation of 10 groups of prickly pear producers that explains 66% of the variations in the production characteristics of prickly pear (Figure 2). Groups 2, 3 and 4 group 50% of producers of prickly pear, while groups 9 and 10 locate individual producers by characteristics very different from the rest of producers. In a study conducted by Martinez *et al*. (2009) formulated a similar analysis defining three types of organic food producers in Spain.

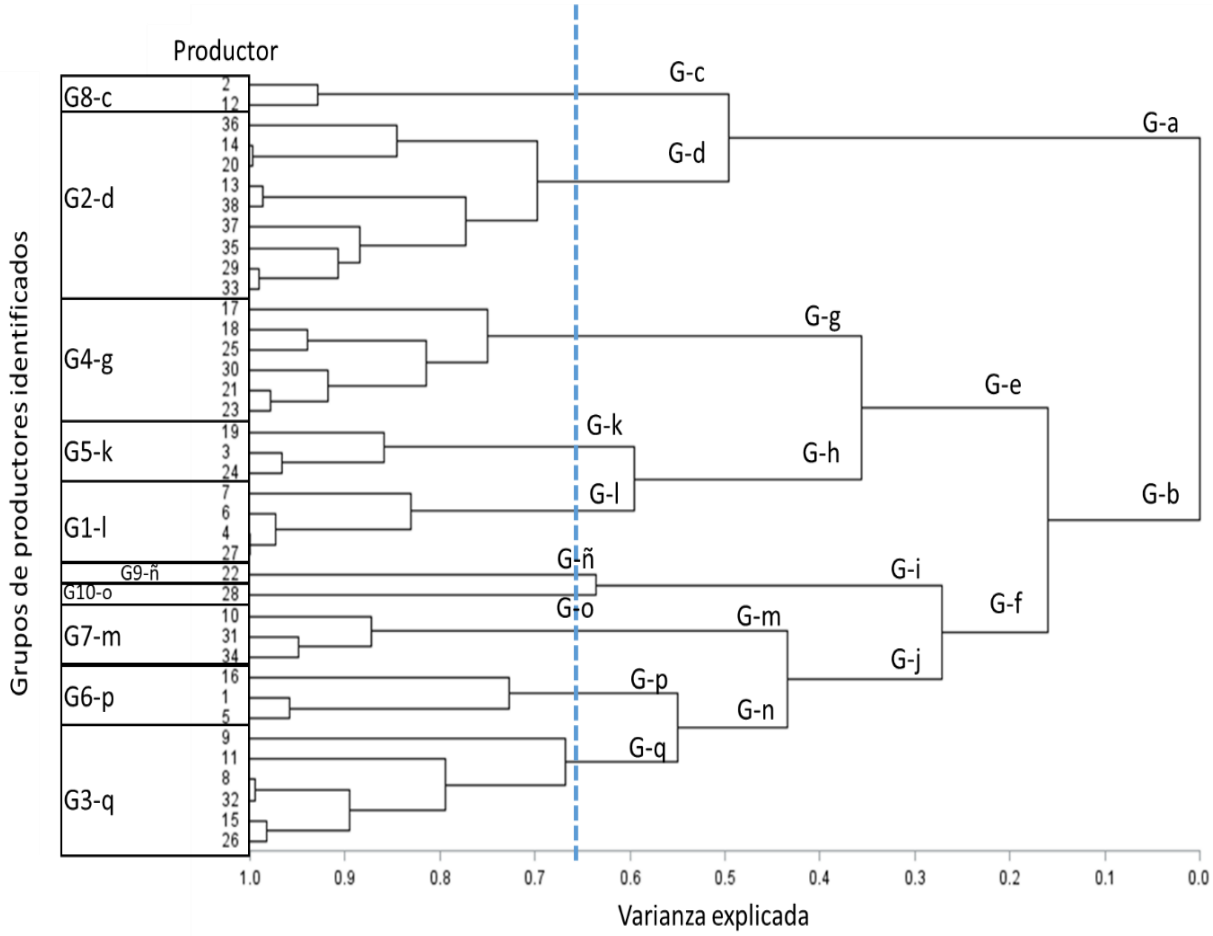

Figure 2. Formation of groups of producers of prickly pear in the municipality of Pinos, Zacatecas, at a r^2 of 0.669 (dotted line) and hierarchical separation of groups. (G= group, lowercase letter= identifier of each group).

In addition to the general description of the producers of prickly pear, the distinctive characteristics of each formed group are integrated:

1) exclusive prickly pear producers without defined age (G1-l): made up of prickly pear producers of variable age between 34 and 63 years, dependent on economic income exclusively for the cultivation of prickly pear (100%) and low yields of production (1.8 at 5 t ha^{-1}). They do not engage in other economic activities and have relationships with producers from the same locality and even outsiders.

2) producers of indeterminate prickly pear (G2-d): producers with variable age (from 34 to 60 years), whose economic income from the cultivation of prickly pear is variable (20 to 80%) linked to activities outside the agricultural and livestock. They have variable production yields (3 to 30 t ha^{-1}) with local partners.

3) rural producers (G3-q): adult producers between 52 and 59 years old, with predominant economic income from prickly pear (50 to 100%) and variable yield (2.5 to 38 t ha^{-1}) that complement their income with livestock activity, related to local partners.

4) non-rural producers (G4-g): older producers (55 and 73 years old), with predominant economic income from prickly pear (50 to 100%) and low production yields (5 to 20 t ha^{-1}) that complement their income with livestock activity and outside the rural area and have local partners.

5) adult producers with very low productivity (G5-k): producers aged between 42 and 61 years, with economic income predominantly from prickly pear (50 to 100%). Their production yield is very low (from 3 to 5 t ha^{-1}) and they have no secondary activity. Their relationship is local or they work individually.

6) exclusive producers of prickly pear, adults and older adults (G6-p): producers in adult age to older adult (48 to 69 years) with economic income from prickly pear (100%) and that are dedicated solely to the cultivation of prickly pear. They have high production yields (46 to 50 t ha^{-1}) and have local partners. One of the producers works individually.

7) young adult producers (G7-m): young producers (33 to 38 years old) with a predominant economic income of the prickly pear (80 to 100%). One of them is also a cattleman. They have high production yields between 40 and 60 t ha^{-1} with local partners.

8) indecisive young adult producers (G8-c): young producers (27 to 36 years old) with income from prickly pear (50 to 60%) as well as very low yields of production (2 and 12 t ha^{-1}). They have complementary activities such as livestock or other outside the rural area and are related to foreign partners.

9) exclusive producer of prickly pear, adult (G9-ñ): producer of medium age (43 years) dedicated solely to the cultivation of prickly pear and therefore total exclusive income (100%). With average production yield (12 t ha^{-1}) related to local partners.

10) producer of prickly pear, older adult (G10-o): adult producer (73 years) with exclusive income for the production of prickly pear and dedicated exclusively to it. The production yield is very low (3.5 t ha^{-1}) and works individually. This differentiation strengthens and corroborates the relevance of differentiated supports, meeting the objectives and productive needs of each group.

In relation to the separation of groups, these were dispersed in the first instance because of the age of the producer and because of their economic dependence on the tunera activity, being the main classification criteria (Figure 3). Groups 10, 6 and 3 are the oldest groups and they depend 100% on the tunera activity, while groups 8 and 2 are composed of young producers who depend very little on tunera activity. In a study conducted by Wanjiku *et al*. (2018) defined five types of producers in the two communities evaluated through a multivariate analysis and principal components; in which CP1 was the income for agricultural production and CP2 was age and non-agricultural income from complementary activities, which is very similar to the present study. 31%

and 41% of their crops evaluated in each community were characterized by having high levels of income from non-agricultural employment and 25% and 39% by depending mainly on agricultural activity. According to the production yield of prickly pear, which is the following separation ratio, the members of group 7 are the most important producers of prickly pear; while the producers of group 4 have the lowest production volumes of prickly pear.

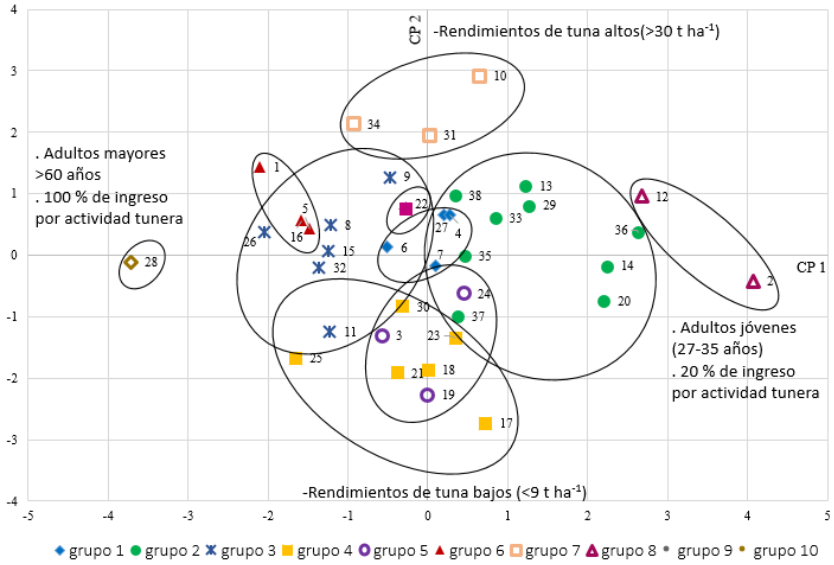

Figure 3. Distribution of prickly pear producers in Pinos, Zacatecas by CP 1 and 2 (r^3= 0.69).

These last groups contain producers between 33 and 73 years old with more than 50% of economic income for the tunera activity. Younger producers may have a broader vision of economic income, since they are not dedicated solely to the cultivation of prickly pear and therefore, they may be more willing to change the tradition of the crop and be interested in creating and promoting other sources of economic income. However, Wanjiku *et al*. (2018) in his study found that the application of new management practices depends on the age and experience of the producers, since the oldest members of the family are those who adopted new skills in the management of their crops. In contrast, the youngest members have jobs outside the agricultural sector and have more school education, which gives them greater access to information, credit and membership in producer cooperatives. If the strengths of the young people and older adults mentioned above are combined, optimal results can be obtained in the management innovation of the productive systems of tuna and in their marketing. On the other hand, they can be encouraged to direct their attention primarily to prickly pear production because they are young adults who have the capacity to carry out field activities.

In order to facilitate the design of strategies for prickly pear producers, producer groups with shared weaknesses were brought together. This scheme, guided by the tools previously used, has been used in other studies to improve and optimize decision-making, fundamentally to better understand the complex system of farmers (Chikowo *et al*., 2014) and to guide strategies for operation and proactive participation (Wanjiku *et al*., 2018).These strategies are listed below.

The first strategy is focused on groups 2 (undecided producers), 4 (non-rural producers), 5 (adult producers with very low productivity), 9 (exclusive producers of prickly pear, adults) and 10 (exclusive producers of prickly pear, older adults). For these producers, should have as a priority objective: increase the yield of prickly pear at a level of 30 t ha^{-1}, in addition, create links with local and foreign producers, it is advisable at least one external relationship per producer. The opportune and transcendental generation of social networks lends credibility in the construction of social capital since it provides multiple opportunities for producers and their interaction with others, which determines access to information (Prokopy *et al*., 2008). The second strategy is for groups 1 (exclusive producers of prickly pear without defined age) and 3 (rural producers). The objectives to be met for this group of producers are increase production volume, strengthen existing relationships through joint work actions that provide benefits and create new links with foreign producers. The third strategy focuses on groups 6 (exclusive producers of prickly pear, adults and older adults) and 7 (young adult producers) to create links with foreign producers. The fourth strategy is aimed at group 8 (indecisive young adult producers) and consists of increasing the volume of production and strengthening existing relationships.

It is necessary to introduce specific strategies according to each type of producer to be effective, which, according to Jelsma *et al*. (2019) should constitute easy access to information, training centers and collaboration with the government to support small and medium producers who mostly reside locally. Each strategy is aimed at improving the current state of the producers of prickly pear, through actions that allow increasing the volume of production of prickly pear linked to the proper management of plantations, as well as increasing fruit quality, strengthening interpersonal relationships and linking with foreign producers with the intention of expanding the market. The characterization of producers and the diversity of groups formed allowed to devise intervention techniques directed to each group, since according to Engler *et al*. (2017) there are measures that can work for one system but not for another. Similarly, Dalogly *et al*. (2014) showed that the types of producers represent different conservation practices and policies and this obeys certain attributes that may be more feasible to introduce new knowledge and management practices (Köbrich *et al*., 2003).

This direction of the vision of work together could generate relationships with companies that allow the transformation of the prickly pear and extend its marketing area. By expanding the market, higher revenues will be generated, which could lead producers to resume the cultivation of prickly pear as their priority activity. This heterogeneity of producers makes it possible to identify specific points to increase agricultural productivity and to know the minimum conditions necessary to intensify the sustainable production of crops (Chikowo *et al*., 2014), being the first step to more effective interventions (Wanjiku *et al*., 2018). This is important to avoid losing tradition, knowledge in the cultivation of this resource and the identity of the region and thus avoid the displacement of families to work areas outside their area. On the other hand, it is necessary to strengthen working relationships with a future projection, since the lack of organization and cooperation limit the strengthening of production (Checa and Velázquez, 2014). These authors mention that marketing initiatives and the acquisition of economic resources that are applied to plantations help to mitigate the vulnerability of the productive system.

On the other hand, Prokopy *et al*. (2008) mentions that the determinants in the adoption of best management practices are: social networks in terms of relations with other producers and access to information since they have positive effects on intervention in critical areas. Information networks provide channels through which producers can obtain information on conservation practices and new technologies (Dalogly *et al*., 2014). There is a strong and positive link between access to information and group affiliation with agricultural income (Wanjiku *et al*., 2018). It should be mentioned that only 29% of the prickly pear producers in Pinos, Zacatecas are formally organized (García *et al*., 2004). Producers that are constituted in cooperatives have the possibility of selling at fixed or agreed price inside and outside the country (Riojas and Fuentes, 2006), which supports the fundamental value of the organization to achieve community development and increase the economic income of a region. The low level of access to information on crop production and poor affiliation in cooperatives is proportional to the adoption of new agricultural management practices.

The producers can be organized; through communal assemblies, being an important mechanism for making decisions and with satisfactory results in production and marketing. These spaces of cooperation are created from the conformation of groups with similar ideals, in addition to that drives the systems towards success by providing economic growth for the community (Ramos, 2014). On the other hand, trust is fundamental since it provides security in the perception of people towards the undertaking of new actions (Checa and Velázquez, 2014). The producers of prickly pear from Pinos, Zacatecas that do not have developed forms of organization, limit the possibility of developing their productive system. One consideration is that intervention strategies must be created that include as many actors as possible. In this context, organized groups with strong relationships are more oriented to the change represented as adoption of new technologies (Marshall *et al*., 2014).

Conclusions

There is a differentiation between prickly pear cactus producers in Pinos, Zacatecas that can be oriented with strategies to promote the productive system in concrete measures such as increasing production volumes and creating and strengthening social relationships.

The application of the multivariate analysis allowed to determine a typification of tuneros producers by similarity of characteristics. Ten types of prickly pear producers were identified based on the age of the producer, the income from the sale of the crop, the yield of prickly pear produced, the existence of a complementary economic activity and the creation of relationships. These types of producers have facilitated the design of four strategies to increase production volumes and promote productive relationships. The analysis of the typification of producers allowed to recognize that, in the municipality of Pinos, Zacatecas there is a productive bipolarity due to the oscillations in the yield of prickly pear that go from 1.8 to 60 t ha^{-1}. The knowledge of distinctive features will be a basis for the design and application of efficient development strategies addressed to each group of producers and allows prioritizing as well as streamlining the distribution of support to the most vulnerable groups of society. Independently of the definition of types of producers, strategies must be generated that allow the linkage and organization between local and foreign producers. These relations must address the sustainability of the productive system, the quality of the product, as well as the commercialization to achieve a development in the production of prickly pear in Zacatecas.

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