Article

Competitiveness and profitability of berries production in Jalisco

Edgar Ricardo Lagunes-Fortiz[1]
Erika Lagunes-Fortiz[3§]
Alma Alicia Gómez-Gómez[1]
Juan Antonio Leos-Rodríguez[2]
José Miguel Omaña-Silvestre[4]

[1]Division of Economic-Administrative Sciences-Chapingo Autonomous University. Highway Mexico-Texcoco km 38.5. Chapingo, State of Mexico, Mexico. CP. 56230. (ricardo_lafo@hotmail.com; almaaliciamx@yahoo.com). [2]Center for Economic, Social and Technological Research on Agroindustry and World Agriculture-Chapingo Autonomous University. Highway México-Texcoco km 38.5, Chapingo, State of Mexico. CP. 56230. Tel. 595 9521000, ext. 6019 y 6020 (jleos@ciestaam.edu.mx). [3]Department of Phytotechnics-Chapingo Autonomous University. Highway Mexico-Texcoco km 38.5. Chapingo, Texcoco, State of Mexico. CP. 56230. Tel. 595 9521500, ext. 6133. [4]Postgraduate Socioeconomics, Statistics and Informatics-Economics-Postgraduate College. Montecillo, Texcoco, State of Mexico. CP. 56230. (miguelom@colpos.mx).

[§]Corresponding author: erika_lagunes@hotmail.com.

Abstract

During 2017, Jalisco was the second state with the highest contribution to the national agricultural GDP (SIAP, 2020). The cultivation of berries is an important socioeconomic activity in this state, which include cranberry (*Vaccinium* spp.), raspberries (*Rubus idaeus*) and blackberries (*Rubus ulmifolius*). Jalisco is the main producer of raspberry, the second of blackberry, and the fourth of strawberry (*Fragaria* spp.) at the national level (FIRA, 2016). However, it is perceived that unlike strawberry and blackberry crops, the cultivated area of raspberries increased in recent years, this increase cannot be explained by changes in price or yield but by other factors. The objective of the study was to determine if there were distortions in the markets that could have influenced the choice of producers in Jalisco for a particular type of berry. It was started from the hypothesis that of the berries, the raspberry had a greater competitive or comparative advantage. To measure the degree of market distortion, the methodology of the policy analysis matrix was applied. The results indicate that the three types of berries were profitable; however, some economic distortions benefited the raspberry and blackberry crops, and negatively impacted the strawberry crop, in addition there was a large subsidy to the profits of the raspberry crop. It is concluded that distortions created by the market and the government influenced the choice of the type of berry to be sown by producers, favoring raspberry production.

Keywords: production decisions, market distortions, policy analysis matrix.

Reception date: September 2020
Acceptance date: November 2020

Introduction

The fruits of the forest, also known as berries (blackberry, strawberry, raspberry and cranberry), are species that, although they require considerable capital investments for their cultivation, their high profitability, the rapid return on investment, the high requirements of labor, the versatility in the production of fruits for consumption and the feasible export possibilities, make them crops with great agricultural potential.

Evidence of this was the annual growth of 21.8% of production during the period 2003-2016, in 2017 the production of berries at the national level was 390 239 tons (SIAP, 2020) and at the international level the demand for these has also presented a constant increase. Mexico exports approximately 41% of its national berry production to the United States of America, Canada, and the Netherlands (SAGARPA, 2017).

The states where the highest berry production is located are Michoacán, Jalisco, Guanajuato and Baja California (SIAP, 2020). Berries are traditionally consumed in the northern regions of America and Europe; however, in recent years the world demand for these products has increased, which has promoted an increase in their production worldwide (González and Johnson, 2015).

Mexico has a great productive potential of berries, together the states of Aguascalientes, Colima, Guanajuato, Jalisco, Michoacán, Nayarit, San Luis Potosí and Zacatecas, are capable of dedicating about 4 085 065 ha to these (SAGARPA, 2017).

This productive potential led the Mexican government to promote the creation and modernization of these crops with techniques such as the incorporation of drip irrigation, the construction of greenhouses and the adoption of protected agriculture in order to increase the productivity of Mexican berries (Nieves *et al*., 2011).

Evidence of the high profitability of the crop is the benefit-cost ratio, which determines the financial viability of a productive project, said ratio is 2.82 for the case of blueberry, 1.88 for raspberry, 1.82 for strawberry and 1.76 in the case of the blackberry; these relationships are higher than those observed in basic crops such as sugar cane and corn, which have a benefit-cost ratio of 1.5 and 1.2 respectively, this resembles the cultivation of berries with other crops that have a high export rate such as avocado, whose cost-benefit ratio is 1.84 (González *et al*., 2020).

Jalisco has ideal climatic and edaphological conditions to produce strawberries, raspberries and blackberries, in addition to the fact that a large number of companies and associations such as Aneberries, Berrymex, Driscoll's dedicated to the national and international marketing of berries are established in that state, in order to guarantee phytosanitary security, promote and defend trade and open new markets for this type of crops (INEGI, 2020).

Jalisco also has important export ports to China, the United States of America (USA), Japan and several countries in Europe, which are the main importers of berries at the national level (SIAVI, 2020) and import of the necessary inputs for the production, packaging and distribution of said products.

Although the state of Jalisco has areas dedicated to the cultivation of the three types of berries, it was observed that in recent years there has been an increase in the areas destined for the production of raspberries and blackberries (Table 1), while the areas destined strawberry production decreased, with the raspberry crop showing the most pronounced growth, this behavior cannot be explained by its sale price to the producer, nor by the increase in yield caused by the creation and adaptation of new technologies these crops, so that other economic distortions could explain such behavior.

Table 1. Growth of the planted area, price per ton, and price of strawberries, raspberries and blackberries for the state of Jalisco.

Year	2013	2014	2015	2016	2017	Increase
			Strawberry			
Sown area (ha)	480	349	246	29	51	-841%
Yield (t ha^{-1})	34	33	40	23	33	-3%
Price ($ t^{-1})	8 893	9 954.5	12 065	14 589	16 560	46%
			Raspberry			
Sown area (ha)	1 512	1 539	2 564	4 448	4 482	66%
Yield (t ha^{-1})	15	14	19	19	19	24%
Price ($ t^{-1})	14 437.34	14 771.5	15 884.89	18 659	19 147	25%
			Blackberry			
Sown area (ha)	431	364.5	344	440.9	536.5	20%
Yield (t ha^{-1})	17	13	13	16	14	-21%
Price ($ t^{-1})	10 131.5	8 451.6	8 772	11 888	14 936	32%

Elaboration with data from the Agri-Food and Fisheries Information Service (SIAP, 2020).

The importance of analyzing how government policies and imperfect market structures affect producers' decisions led different authors to carry out studies that measured the competitive and comparative advantages of different crops; through the use of the policy analysis matrix (MAP) methodology, the results of which determine the current situation of competitiveness in agricultural activity and the policy instruments that affect it (Monke and Pearson, 1989).

In 2004 a study was carried out to measure the evolution of the profitability and competitiveness of the red tomato in the state of Sinaloa (Hernández *et al*., 2004), the results show that the crop had comparative advantages in the international market during the autumn-winter 1999-2000 cycle, which explained the decision of producers to produce and export this crop, in June 2011 a similar study was carried out for the cultivation of vanilla under different production systems (Barrera-Rodríguez *et al*., 2011).

According to the results, the crop was negatively affected by economic policies such as taxes on inputs, interest rates and an overvalued exchange rate, reducing the profits of producers in the Totonacapan region, a last example is the study carried out with the objective of measuring the competitiveness of the wheat crop in Pakistan at the importer and exporter level (Anwar *et al*., 2005), where the authors concluded that the crop had comparative advantages at the import level, however, it did not present any in export, which limited its production.

Based on the above and in the case of berries, it is thought that there were most likely economic distortions that benefited the cultivation of raspberries in the state of Jalisco, increasing its profitability and competitiveness with respect to the cultivation of strawberries and blackberries, favoring growth in their production. The objective of the study was to analyze and compare the profitability, competitiveness and comparative advantages of the raspberry, strawberry and blackberry crops of Jalisco, during the year 2017.

The justification for this study lies in the economic importance of the three crops for the state of Jalisco, this being the main producer of raspberries, the second in blackberries and the fourth in strawberries, whose area planted as a whole was 5 070 ha. with a value of 1 788 791.88 thousand pesos during 2017 (SIAP, 2020).

Materials and methods

This study focused on the three most important types of berries: strawberry (*Fragaria ananassa*), raspberry (*Rubus idaeus*) and blackberry (*Rubus ulmifolius*), leaving aside blueberries (arandanos azules) and cranberries because these are shrubs whose production logistics is different.

The data available on the production costs of raspberry, strawberry and blackberry were used, coming from different sources, mainly from the Agrocost System published by Trusts Instituted in Relation to Agriculture (FIRA, 2020), the National Information and Integration System of Markets (SNIIM, 2020), the Bank of Mexico (BANXICO, 2020) and different berry planting manuals published by the National Institute of Research, Agricultural and Livestock Forestry (INIFAP, 2020), all for a production system with irrigation by drip, using improved seedlings and fertilization with agrochemicals for the 2017 sowing period (Table 2).

Table 2. Cost structure (%) of raspberry, strawberry and blackberry crops.

Cycle	Perennial		
Technology	Improved seedling - fertilized - pump irrigation		
Period	2017		
Area	1 ha protected		
Crop	Blackberry	Strawberry	Raspberry
Marketable inputs	42.84	67.58	59.62
Fertilizers	10.69	9.25	16.42
Fungicides	2.81	1.81	2.1
Herbicides	0.24	0.15	0.18
Insecticides	1.7	0.21	0.59
Seedlings	19.33	48.78	34.02
Others	7.93	7.29	6.2
Diesel	0.15	0.09	0.11
Hired services	0	0	0
Internal factors	48.15	28.72	36.85

Manual labor	21.5	8.22	13.42
Mechanized work	7.77	4.56	6.08
Avio credit (interest)	5.59	5.86	5.86
Agricultural insurance	4.68	4.89	4.88
Use of water	0.68	0.54	0.42
Electricity	0.6	0.35	0.47
Diverse materials	0.08	0.05	0.06
Ground	7.25	4.25	5.67
Indirectly tradable inputs	0.11	0.06	0.09
Tractor and implements	0.1	0.06	0.08
Pumping equipment	0.01	0.01	0.01
Administration and services	8.9	3.64	3.44
Total cost	100	100	100

Elaboration with FIRA planting plans (2020), calculating prices and quantities for the state of Jalisco, SNIIM prices (2020), INIFAP technology packages (2020), Banxico interest rates (2020), information of transport of the SCT (2020) and information of producers of the state of Jalisco. Fertilizers include growth regulators; others include metam sodium, mulch plastic for planting and drip irrigation hose.

To determine the parity import prices, he referred to the United States of America as the country of origin of the different inputs used, specifically the state of Oregon which is the main exporter of blackberries to Mexican territory and California for strawberry crops. and raspberry, these prices of inputs and products were taken from the databases published by the National Agricultural Statistics Service (USDA, 2020) and from institutions dedicated to the sale of agricultural inputs for those products for which there is no information in official sources.

The analysis method used to determine the degree of distortion in the profitability of berries was the MAP, which was developed at Cornell University (Monke and Pearson, 1989), this allows to measure how distortions in the market affect the profitability and competitiveness of agricultural products, as well as efficiency in the use of resources in production systems.

The way in which the MAP measures the economic impact of failures in the market is by calculating the difference between the so-called private prices, which are those observed in reality, and the social prices, which are those that would exist if divergences did not occur in the market. The MAP is made up of three rows, which contain the cost, income and profit of the economic activity calculated with the prices existing in the market, called private prices, the second with the same indicators calculated with the prices they would have in the case of there should be no distortions in the market called economic prices or shadow prices and finally the third.

Where the divergences caused by the effect of distortions and policies are measured, in the case of the columns, the yields are obtained by multiplying the prices by the yield per hectare measured in tons, the costs are divided into two, the marketable that are those that can be acquired in the market and internal factors that are those that cannot be traded between countries or do not have an explicit price such as the depreciation of technological equipment, finally the profit which is the difference between income and costs (Table 3).

Table 3. The policy analysis matrix (MAP).

Concept	Income	Costs		Profit
		Tradable goods	Internal factors	
Private prices	A	B	C	D
Social prices	E	F	G	H
Divergences	I	J	K	L

The policy analysis matrix for agricultural development (Monke and Pearson, 1989).

Where: A and E: income at private and economic prices B and F: costs of tradable goods at private and economic prices C and G: costs of internal factors at private and economic prices, D= A-(B+C) and H= E-(F+G) is private and economic profit, I= A-E, J= B-F and K= C-G measure transfers through output, tradable inputs and factors of production and L= I-J-K= D-H measures net transfers.

Once the necessary information on the technical coefficients, the prices of inputs and products at a private and economic level was compiled, three different MAP were created, one for each product analyzed. For this, the information was arranged so that tradable goods could be identified, which are all those production factors that can be acquired in the market and therefore have a price and internal factors, which are those used in production. of these products but they are not priced in the market; information on the cost of irrigation, the amount of wages required for agricultural activities, the activities carried out with machinery and other contracted services such as technical consultancies, hiring mobile toilets and others.

From the results of the MAP, transfers (subsidies and taxes), measured as the differences between private and economic prices, can be determined (Table 4). The magnitude of these determines the degree of distortion in the market for different reasons such as government policies or the existence of imperfect market structures.

Table 4. Policy analysis matrix: protection coefficients, efficiency ratios, subsidies, profitability and added values.

Concept	Equation
Nominal product coefficient (CNPP)	CPNP= A/E
Nominal coefficient of tradable inputs (CNPI)	CPNI= B/F
Coefficient of effective protection (CPE)	CPE= (A-B)/(E-F)
Private cost efficiency	RCP= C/(A-B)
Cost efficiency of internal resources	RCR= G/(E-F)
Producer social subsidy	SSP= L/E
Equivalent to producer subsidy	ESP= L/A
Producer profit subsidy	SGP= D/H
Private profitability	RRP= D/(B+C)
Social profitability	RRE= H/(F+G)
Value added to private wrecks	VAP= (A-B)
Added value at affordable prices	VAE= (E-F)
Intermediate consumption in total income	PCIP= (B/A)
Value added in total income	PVAP= (A-B)/A

Policy analysis matrix for agricultural development (Monke & Pearson, 1989).

Of the coefficients obtained in this study, those that could explain the increase in the cultivated area of raspberry were and were analyzed and are the following: the nominal protection coefficient of marketable and non-marketable inputs, which measures the effect of the distortions in the price of inputs, is obtained from the ratio between the price of private inputs.

Which are those that the producer has to pay at the farm level, among the economic prices of agricultural inputs, which are those that should exist in the absence of distortions, if the coefficient has a value greater than the unit, it indicates that the producer pays a higher price than he should; in other words, inputs have a higher local price in relation to international markets, probably due to the presence of distortions in the domestic market, which is a deterrent to producers.

The effective protection coefficient, which measures the total effect of the distortions, considering the tradable inputs and the final product, is calculated by dividing the profits at private prices by the profits at economic prices. Analogously, a value above the unit indicates that the farmer is receiving a higher profit than he would have in perfect market conditions, since in this case the protection of both the product and the inputs generates a positive net protection, which represents profits for the producers.

The private cost efficiency ratio (RCP) is a relationship through which the profits created by agricultural activity are measured and it is calculated by dividing the internal factors by the income, discounting the costs of those products that have a price in the market, the reason for using private prices is because they are the ones in force in the market.

An indicator less than the unit expresses that extraordinary profits are being received, since, when paying the production factors, there is a residual in the added value, which is the remuneration for the management of the producer, while an indicator greater than the unit indicates that the activity is not capable of paying the factors of production and therefore not generated profits.

The cost efficiency ratio of internal resources (RCI), if the magnitude of this indicator is between 0 and 1, means that the value of internal resources (those that are not acquired in the market) used in production is less than the value of the currency earned or saved; this means that there is a comparative advantage in the domestic production of the country under analysis.

A value greater than unity indicates that the value of the internal resources used in production exceeds the foreign exchange saved, earned or saved, therefore, the country does not have a comparative advantage. A negative relationship indicates that foreign exchange is used in the production of the product that it is worth in the market. And the subsidy relationship which are: the social subsidy to the producer (SSP).

Which shows the proportional part that should be supported by the producer's gross income to maintain the current level of private earnings in the face of a total commercial opening; the producer equivalent subsidy (SEP) which is the total divergence or net policy transfer, as a proportion of total gross income at private prices and finally the producer profit subsidy (SGP) which measures the degree to which private profits exceed economic profits (Lara *et al*., 2003).

Results and discussion

The results obtained are presented in Figure 1 and 2, it is important to note that since the main insecticide used to control pests in crops has as active ingredient 'paraquat' (1,1" - dimethyl-4, 4"-bipyridinium) and the marketing of this agrochemical is strict, it was determined that there is no way to transport it without governmental contingencies that distort its price, so that a higher price will always be paid for the product.

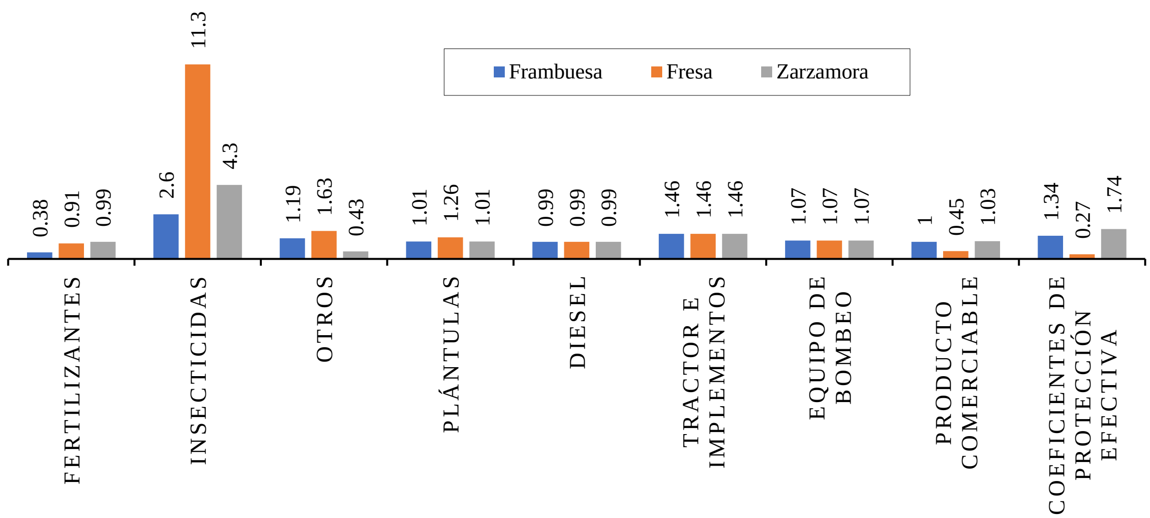

Figure 1. Nominal and effective protection coefficients for improved, fertilized and pumped irrigation raspberry, strawberry and blackberry crops in 2017 for the state of Jalisco.

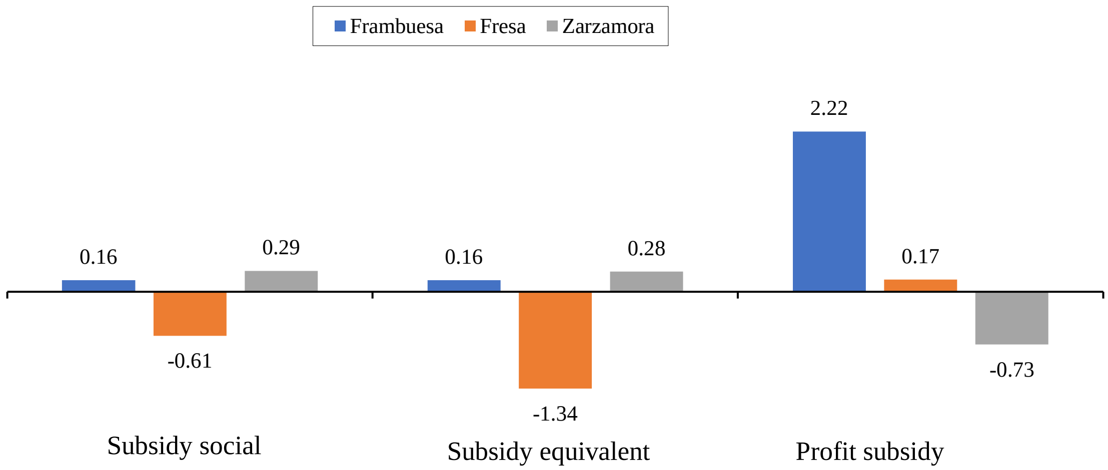

Figure 2. Subsidy ratios for improved, fertilized, and pumped-irrigated raspberry, strawberry and blackberry crops in 2017 for the state of Jalisco.

Nominal input protection coefficient (CNPP), nominal input protection coefficient (CNPI) and effective protection coefficient (CPE)

The protection indicators used to show the degree of protection of domestic production with respect to foreign production are the CNPP and the CPE, the former helps to understand the way in which price policies incentivize or disincentive producers, while the second is a measure of the degree of transfer to output and inputs derived from trade policy and the exchange rate.

The results show that the policies benefited producers in the purchase of fertilizers, especially in the case of raspberries, which acquired these products for 38% of the price they should have paid, and agricultural diesel, which for all crops paid a lower price. However, it is observed that in all cases there was a lack of protection in the acquisition of insecticides, seedlings and mechanical implements, in the case of insecticides the producers paid more than double, those of blackberry four times and those of strawberry presented the greatest lack of protection having to pay eleven times more than necessary; in the case of implements, all had to pay 50% more for the acquisition of tractors and agricultural implements.

When analyzing and comparing the subsidy to the marketable product, we can observe that both the raspberry and blackberry did not present a significant degree of protection or lack of protection; however, in the case of strawberries, the product presented a high level of lack of protection, since the price obtained was approximately 50% lower than it should have been.

As a total protection measure it is have that, when comparing the effective protection coefficient, the raspberry and blackberry presented an important degree of protection since the value obtained is greater than unity, the second being the most benefited with a value of 1.74, while that the strawberry presented a very high degree of deprotection (Figure 1). The results show that despite the fact that the three crops were profitable, the strawberry presented a high degree of lack of protection, discouraging producers and guiding them to choose raspberry and blackberry crops.

Private cost efficiency relationships (RCP) and internal factor cost (RCI)

The private cost ratio (RCP) allowed to compare the private efficiency, the results showed that in the three crops the RCP resulted with positive values greater than zero, so that the crops are profitable and competitive, for the raspberry the indicator was 0.49, the strawberry 0.47 and the blackberry 0.8, in such a way that it is more convenient to produce it internally than to import it, the raspberry being the most competitive crop and the blackberry the least competitive, since its value is the closest to the unit.

It is important to note that although these values were higher than those observed in other export crops such as avocado, which on average has indicators close to 0.1, which implies lower competitiveness, berries have a higher cost-benefit ratio, although the avocado production is more competitive (Franco *et al*., 2018).

Comparatively, a study carried out in order to measure the profitability of corn production in the state of Guanajuato (Guzman *et al*., 2014) obtained 0.04 for the production of corn in rainfed, 0.13 in assisted irrigation with cattle and 0.85 in assisted irrigation without livestock; which means that an important factor to consider when analyzing the profitability of a product is the degree of technological development present at the farm level (González and Alferes, 2010), a factor that is present to a high degree in berry crops, especially in the case of raspberries due to the post-harvest handling that this product requires.

For the internal resource cost efficiency ratio (RCI), the resulting values were 0.69 for raspberry, 0.12 for strawberry and 1.46 for blackberry, in this case only strawberry and raspberry have a comparative advantage in relation to with the production of the United States of America, since for each peso invested 0.69 and 0.12 are for the payment of internal factors and the rest is possible utility.

Relationships of social subsidy to producer (SSP), equivalent subsidy to producer (SEP) and subsidy to producer’s profit (SGP)

When analyzing the subsidy relationships and focusing particularly on the producer’s profit ratio (SGP), it is observe that the raspberry presented a significant profit subsidy, private profits exceeded economic ones by more than double, this means that there is a great incentive to produce this product above the others, according to the results obtained, the raspberry obtained a value of 2.22, the strawberry 0.17, and the blackberry -0.73, this means that private profits are overvalued in the case of raspberry , which places the former above other important crops for the state's international trade, such as the red tomato, which has a value of 0.54 (Hernández *et al*., 2004), while the opposite occurs in the case of the strawberry where profits are undervalued 83% with respect to economic.

In the case of the other two indicators, we can see that the raspberry also benefited more compared to the blackberry crop (for the strawberry, because it has a negative value, there is no interpretation since one of the values is negative), since the value of the subsidy to the producer is lower, so it is less exposed to a total opening, and the divergence of transfers as a proportion of gross income is less (Figure 2).

Conclusions

The policy analysis matrix (MAP) made it possible to identify and quantify some of the policy distortions on prices that exist in the production systems of the berries studied in this research (strawberry, raspberry and blackberry) which allowed to estimate the it is the cost for producers to allocate their resources for the production of a certain type of berries, in such a way that the MAP provides the elements to visualize profitability both from the producer’s point of view and as that taking into account the efficient use of productive resources of the country.

The results indicate that the reason for the increase in the area planted with raspberries in 2017 was largely due to the protection that existed in the berry market, which benefited the raspberry crop in a greater proportion. There was a greater profit margin for the producers since the subsidies in the purchase of fertilizers and the benefit in the price of raspberries were much higher than the taxes in the other inputs.

Raspberries also showed greater competitiveness compared to raspberries produced in the United States (USA), increasing their export potential. Instead, these distortions and failures harmed strawberry and blackberry producers (especially the former), discouraging their production. If the protection for raspberries continues, it is expected that the area devoted to this crop will continue to increase, while those for strawberries and blackberries will probably remain stable or even decrease.

According to some studies, one of the reasons why blackberry cultivation has stopped being produced in many of the regions of Jalisco has been the high incidence of pests and diseases, which have increased in recent years. The results of this work support this assertion, it can be observed that there is a lack of protection in the acquisition of insecticides for blackberry producers, who must pay a higher price to acquire said agrochemicals, resulting in the acquisition and application of pesticides in doses that they are not optimal, causing the proliferation of pests and diseases.

The results obtained in this article coincide with those of other studies carried out to analyze the berry market in Mexico (González *et al*., 2020), beyond geographical conditions, there are different advantages which have driven the production of berries, factors such as the existence of a strong institutional and governmental base, the development and adaptation of new techniques, and the insertion of Mexico in the global chain have promoted adoption in the production of these crops; however, government interference and the existence of agents that control the prices of inputs and products represent a threat to the development and expansion of the production of berries in Jalisco.

Cited literature

Anwar, S.; Hussain, Z. and S. J. M. 2005. Comparative advantage and competitiveness of wheat crop in Pakistan. Lahore Journal of Economics, Department of Economics, The Lahore School of Economics. USDA. National Agricultural Statics Service. United States Department of Agriculture. 10(2):101-110. https://www.nass.usda.gov/.

Banxico. 2020. Banco de México. Indicadores económicos. https://www.banxico.org.mx/.

Barrera-Rodríguez, A. I.; Jaramillo-Villanueva, J. L.; Escobedo-Garrido, J. S. y Herrera-Cabrera, B. E. 2011. Rentabilidad y competitividad de los sistemas de producción de vainilla (*Vanilla planifolia* J.) en la región del Totonacapan, México. Agrociencia. 45(5):625-638.

FIRA. 2015. Fideicomisos Instituidos en Relación a la Agricultura. Panorama Agroalimentario. Berries 2016.https://www.gob.mx/cms/uploads/attachment/file/200633/panorama_agroalimentario_berries_2016.pdf.

FIRA. 2020. Fideicomisos Instituidos en Relación con la Agricultura. Agrocostos. https://www.fira.gob.mx/nd/agrocostos.jsp.

Franco, S. M. A.; Leos, R. J. A.; Salas, G. J. M.; Acosta, R. M. and García, M. A. 2018. Analysis of costs and competitiveness in avocado production in Michoacán, Mexico. Rev. Mex. Cienc. Agríc. 9(2):391-404.

González, A. and Alferes, M. 2010. Competitiveness and comparative advantage of maize production in Mexico. Rev. Mex. Cienc. Agríc. 1(3):381-396.

González, M. E. and Johnson, M. H. 2015. Anthocyanins From berries: chemistry and roles in inflammation and diabetes. Encyclopedia of Life Support Systems (EOLSS)/UNESCO, 15. Singapure.

González, R. M. G.; Santoyo, C. V. H.; Arana, C. J. J. and Muñoz, R. M. 2020. The insertion of Mexico into the global value chain of berries. World Development Perspectives. 20:100-240. https://doi.org/10.1016/j.wdp.2020.100240.

Guzmán, S. E.; De La Garza, C. M. T.; García, S. J. A.; Rebollar, R. S. y Hernández, M. J. 2014. Rentabilidad privada de la producción de maíz en la región Bajío de Guanajuato, México. Rev. Facultad Nacional de Agronomía Medellín. 67(2):7291-7299.

Hernández, M. J.; García, M. R.; Vaca, A.; Valdivia, A. R. y Omaña, S. J. M. 2004. Evolución de la competitividad y rentabilidad del cultivo del tomate rojo (*Lycopersicon esculentum* L.) en Sinaloa, México. Agrociencia. 38(4):431-436.

INEGI. 2020. Instituto Nacional de Estadística y Geografía. Directorio de empresas y establecimientos. https://inegi.org.mx/temas/directorio/.

INIFAP. 2020. Instituto Nacional de Investigación Forestal y Agropecuaria. https://www.gob.mx/inifap.

Lara, C. D.; Mora, F. J. S.; Martínez, D. M. A.; García, D. G.; Omaña, S. J. M. y Gallegos, S. J. 2003. Competitividad y ventajas comparativas de los sistemas producción de leche en el estado de Jalisco, México. Agrociencia. 37(1):85-94.

Monke, E. A. and Pearson, S. R. 1989. The policy analysis matrix for agricultural development. Cornell University Press. Ithaca, New York., USA and London England. 279 p.

Nieves, G. V.; Van-der, V. O. and Elings, A. 2011. Mexican protected horticulture: production and market of Mexican protected horticulture described and analysed. Wageningen UR Greenhouse Horticulture/LEI. 104 p. https://edepot.wur.nl/196070.

SAGARPA. 2017. Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Agricultura. Planeación Agrícola Nacional 2017-2030. Frutas del bosque. https://www.gob.mx/cms/uploads/attachment/file/257076/potencial-frutas_del_bosque.pdf.

SCT. 2020. Secretaría de Comunicaciones y Transportes. Rutas punto a punto. Traza tu ruta. http://app.sct.gob.mx/sibuac_internet/controllerui?action=cmdescogeruta.

SIAP. 2017. Servicio de Información Agroalimentaria y Pesquera. Datos anuales de producción y valor de producción de fresa, frambuesa y zarzamora. https://www.gob.mx/siap.

SIAVI. 2020. Sistema de información arancelaria Vía Internet. Secretaría de Economía. http://www.economia-snci.gob.mx/.

SNIIM. 2020. Sistema Nacional de Información e Integración de Mercados. Secretaría de Economía. http://www.economia-sniim.gob.mx/nuevo/.

USDA. 2020. National Agricultural Statics Service. United States Department of Agriculture: https://www.nass.usda.gov/.