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Comparativos de custos de produção de soja convencional e transgênica em diferentes regiões no Brasil

Comparison of conventional and transgenic soybean production costs in different regions in Brazil

Comparación de los costos de producción de soja convencionales y transgénicos en diferentes regiones de Brasil

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Resumo

A cultura da soja é uma das culturas de maior importância econômica do agronegócio brasileiro e no mundo, com a expansão da cultura sempre ligado a avanços científicos e a novas tecnologias de produção. Diante do exposto, objetivou-se com este estudo, avaliar os custos de produção de vinte e uma regiões produtoras para determinar o maior e menor custo de produção na 1º safra em três anos agrícolas e na safra de verão em dois anos agrícolas, com a soja convencional e transgênica, além de comparar o custo de produção dos sistemas de cultivo. Quanto aos procedimentos técnicos, foi realizada uma pesquisa descritiva com dados estatísticos fornecidos pela Companhia Nacional de Abastecimento. Foram analisados os anos agrícolas de 2018, 2019 e 2020 da cultura de soja em vinte e um municípios brasileiros, localizados nos estados brasileiros: Bahia, Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Piauí, Rio Grande do Sul, Roraima e Tocantins. A região de Primavera do Leste - MT demonstrou uma região com alto custo de produção em comparativos com outras regiões produtoras. Os menores custos variaram entre várias regiões, em função do sistema de cultivo empregado. A produção de soja transgênica demonstrou ser a opção mais rentável e promissora pelo menor custo de produção em relação ao cultivo de soja convencional.

Palavras-chave: Dólares por hectare; 1º safra; Safra verão; Produtores; *Glycine max.*

Abstract

The soybean crop is one of the most economically important crops in Brazilian agribusiness and in the world, with the expansion of the crop always linked to scientific advances and new production technologies. In view of the above, the objective of this study was to evaluate the production costs of twenty-one producing regions to determine the highest and lowest production costs in the first harvest in three agricultural years and in the summer harvest in two agricultural years, with the conventional and transgenic soybeans, in addition to comparing the cost of production of the cultivation systems. As for technical procedures, a descriptive research was carried out with statistical data provided by the National Supply Company. The agricultural years of 2018, 2019 and 2020 of soybean culture were analyzed in twenty-one Brazilian municipalities, located in the Brazilian states: Bahia, Distrito Federal,

Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Piauí , Rio Grande do Sul, Roraima and Tocantins. The region of Primavera do Leste - MT demonstrated a region with a high cost of production in comparison with other producing regions. The lowest costs varied between several regions, depending on the cultivation system employed. The production of transgenic soybeans proved to be the most profitable and promising option due to the lower production cost in relation to the cultivation of conventional soybeans.

Keywords: Dollars per hectare; 1st harvest; Summer harvest; Producers; *Glycine max.*

Resumen

El cultivo de soja es uno de los cultivos económicamente más importantes en los agronegocios brasileños y en el mundo, con la expansión del cultivo siempre vinculada a los avances científicos y las nuevas tecnologías de producción. En vista de lo anterior, el objetivo de este estudio fue evaluar los costos de producción de veintiuna regiones productoras para determinar los costos de producción más altos y más bajos en la primera cosecha en tres años agrícolas y en la cosecha de verano en dos años agrícolas, con el soja convencional y transgénica, además de comparar el costo de producción de los sistemas de cultivo. En cuanto a los procedimientos técnicos, se realizó una investigación descriptiva con datos estadísticos proporcionados por la National Supply Company. Los años agrícolas de 2018, 2019 y 2020 del cultivo de soja se analizaron en veintiún municipios brasileños, ubicados en los estados brasileños: Bahía, Distrito Federal, Goiás, Maranhão, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Paraná, Piauí, Rio Grande do Sul, Roraima y Tocantins. La región de Primavera do Leste - MT demostró una región con un alto costo de producción en comparación con otras regiones productoras. Los costos más bajos variaron entre varias regiones, dependiendo del sistema de cultivo empleado. La producción de soja transgénica resultó ser la opción más rentable y prometedora debido al menor costo de producción en relación con el cultivo de la soja convencional.

Palabra clave: Dólares por hectárea; Primera cosecha; Cosecha de verano; Productores; *Glycine max.*

1. Introduction

The soybean crop is one of the most economically important crops in Brazilian agribusiness and the world. According to the increase in soybean production in Brazil, the

2019/20 crop grew by 2.7% in planted area and production estimated at 122.1 million tons, being the record in the historical series, highlighting the country as a potential product in the world (Conab, 2020).

The increase in soybean culture in the country has always been linked to scientific advances and the availability of new technologies to the production sector (Freitas, 2011), besides, the soy production system increasingly requires a certain degree of technical knowledge, economic and administrative, to guarantee the best results, aiming at greater competitiveness, as well as to elaborate the best planning in the production unit and the management of resources as an aid tool in decision making (Artuzo et al., 2018).

Soy is one of the main commodities, being a source of raw material in the production of bran and oil, among other products, being commercially grown in Brazil for just over 40 years (Ferreira et al., 2015). A characteristic of such a crop is the intensive use of technology during all stages of production, such as transgenic soybeans, which increase productivity and quality to the harvested product (Reis et al., 2001).

The importance of soy for the Brazilian and world scenario is explicit, which is why it is a highly technified crop and studied by several authors (Ferreira et al., 2015), with no data in the literature regarding the measurement of production costs with conventional and transgenic soybeans in the 1st and/or summer harvest.

Because of the above, given the importance of soy for Brazilian agriculture, the objective of this study was to evaluate the production costs of twenty-one producing regions to determine the highest and lowest production costs in the first harvest in three agricultural years and the summer harvest in two agricultural years, with conventional and transgenic soybeans, in addition to comparing the production cost of the cultivation systems.

2. Materials and Methods

As for the technical procedures used in this study, exploratory research was carried out with statistical data provided by the Agricultural Information Portal of the Agricultural Observatory of the National Supply Company (Conab, 2020). Statistical data were analyzed in the agricultural years of 2018, 2019 and 2020 for soybeans (*Glycine max* (L.) Merrill) in twenty-one Brazilian municipalities. The nature of the work is of the quantitative type (Pereira et al., 2018).

The Brazilian municipalities analyzed in this study were Brasília - Distrito Federal (DF), Cristalina - Goiás (GO), Rio Verde - GO, Chapadão do Sul - Mato Grosso do Sul (MS),

Dourados - MS, Sorriso - Mato Grosso (MT) , Campo Novo do Parecis - MT, Primavera do Leste - MT, Barreiras - Bahia (BA), Ferries - Maranhão (MA), Uruçuí - Piauí (PI), Pedro Afonso - Tocantins (TO), Boa Vista - Roraima (RR) , Unaí - Minas Gerais (MG), Campo Mourão - Paraná (PR), Londrina - PR, Ponta Grossa - PR, Francisco Beltrão - PR, Cruz Alta - Rio Grande do Sul (RS), Ijuí - RS and São Luiz Gonzaga -RS.

The costs of producing conventional and transgenic soybeans in the 1st harvest in the agricultural years 2017/18, 2018/19 and 2019/20 and in the summer harvest in the agricultural years 2017/18 and 2018/19 were analyzed. Production costs (R $ / ha) were calculated according to the average productivity (kg/ha) of each soybean-producing municipality considering the harvests, material used (conventional or transgenic) and the agricultural years. Statistical data were obtained by Conab (2020) and the cities analyzed were presented in Table 1.

Table 1. Municipalities producing conventional and transgenic soybeans in the 1st harvest in the 2017/18, 2018/19 and 2019/20 harvests and the summer harvest in the 2017/18 and 2018/19 harvests.

	1st Harvest						Summer Crop			
	Conventional			Transgenic			Conventional		Transgenic	
	17/18	18/19	19/20	17/18	18/19	19/20	17/18	18/19	17/18	18/19
Brasília - DF				X	X	X	X		X	X
Cristalina - GO	X	X		X	X	X	X			X
Rio Verde - GO				X	X	X	X			X
Chapadão Do Sul - MS				X	X		X		X	X
Dourados - MS						X				
Sorriso - MT	X	X	X	X	X	X	X	X	X	X
Campo Novo do Parecis - MT	X	X	X	X	X	X	X	X	X	X
Primavera Do Leste - MT	X	X	X	X	X	X	X	X	X	X
Barreiras - BA				X	X	X	X		X	X
Balsas - MA				X	X	X	X			X
Uruçuí - PI						X				
Pedro Afonso - TO					X	X			X	X
Boa Vista - RR	X	X	X				X	X		
Unaí - MG					X	X			X	X
Campo Mourão - PR					X	X			X	X
Londrina - PR	X	X	X		X	X		X	X	X
Ponta Grossa - PR			X							
Francisco Beltrão - PR			X							
Cruz Alta - RS					X				X	X
Ijuí - RS						X				
São Luiz Gonzaga - RS					X				X	X

Source: The authors.

In both, in conventional or transgenic soybeans in the first harvest or summer harvest, the items that integrated production costs were: administrator, pesticides, soil analysis, labor, fertilizers, seeds, miscellaneous services, tractors and harvesters, interest financing, technical assistance, a special contribution to rural social security, administrative expenses, storage costs, external transport.

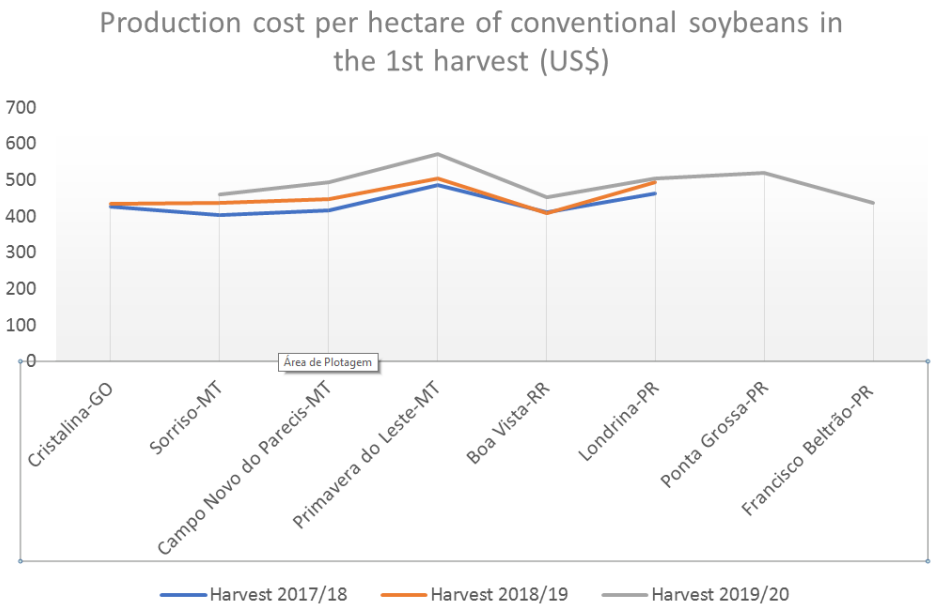
The statistical data analyzed were provided in Brazilian reais (R$), but in this study,

the currency used was US dollars (US$), obtained by converting the exchange rate: US$ 1 = R$ 5,22 (Ipea, 2020).

3. Results and Discussion

The costs of conventional soybean production per hectare in the 1st harvest in the municipalities of Cristalina, in GO, Sorriso, Campo Novo de Parecis and Primavera do Leste, in MT, Boa Vista, in RR, Londrina, Ponta Grossa, and Francisco Beltrão, in PR in the 2017/18, 2018/19 and 2019/20 seasons were described in Graph 1.

Graph 1. The production cost of conventional soybeans per hectare (US$/ha) in the first harvest in the main producing regions in Brazil.



Source: The data were obtained by Conab (2020).

The highest production costs per hectare observed in the 2017/18 crop were in Primavera do Leste - MT, with US$ 485.48 and Londrina - PR, with US$ 462.05. Among the cities analyzed, production costs in the 2018/19 harvest increased, but the cities with the highest costs remained, with US$ 502.66 and US$ 494.29, respectively. In the 2019/20 harvest, the highest production costs were in Primavera do Leste - MT, with US$ 571.77, Ponta Grossa - PR, with US$ 520.44 and Londrina - PR, with US$ 504.74.

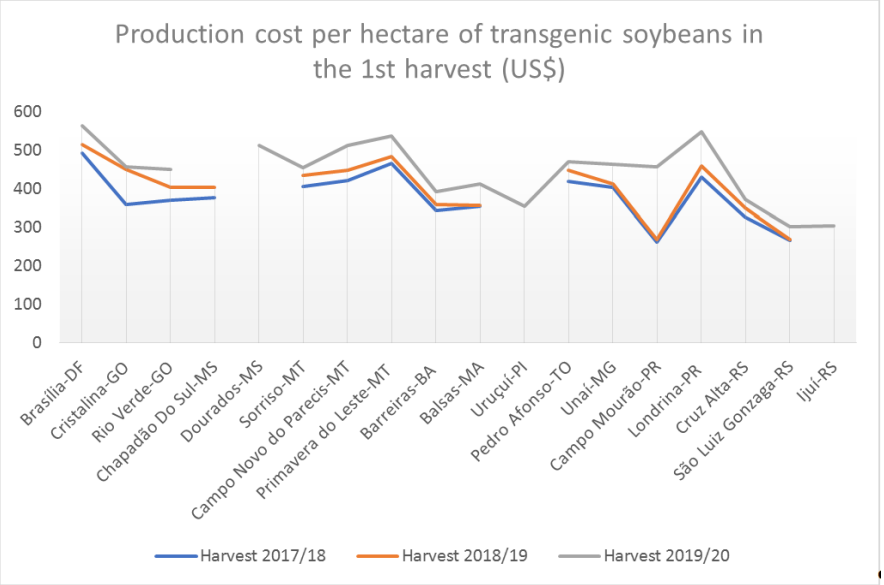
Although production costs are higher in Primavera do Leste - MT and Londrina - PR, Artuzo et al. (2018), claim even with the possibility of implementing production technologies, there is a variation in productivity in different Brazilian states, and in general, soybean production is concentrated in the South and Midwest, being the MT, PR together with RS, historically, are among the states that present the highest productivity (Conab, 2017).

The lowest production costs per hectare in the 2017/18 harvest were observed in the regions of Sorriso - MT, with US$ 402.99 and Boa Vista - RR, with US$ 409.33. In the subsequent crop, 2018/19, Boa Vista - RR saw a reduction in its cost, staying at US$ 408.99, the lowest cost, accompanied by Cristalina - GO, with US$ 433.33. In the 2019/20 harvest there were significant increases in costs, reaching the US$ 458.75 in Sorriso - MT and US$ 452.58 in Boa Vista - RR, being higher than the Francisco Beltrão - PR region, with US$ 436.67, with the lowest crop production cost.

According to Menegatti & Barros (2006), when analyzing production costs with field data in the state of MS, they observed the cost of US$ 293.19 in the 2004/05 harvest of conventional soybeans. The increase in production costs is related not only to increased productivity but also to the use of seeds with high productive potential, application of fertilizers in quantities necessary for the full development of the crop, the ideal time for sowing, efficiency in pest control and diseases (Inácio et al., 2015; Paré et al., 2015; Roberts & Johnston, 2015, Artuzo et al., 2018).

The costs of producing transgenic soybeans per hectare in the 1st harvest in the cities of Brasília - DF, Cristalina and Rio Verde, in GO, Chapadão do Sul and Dourados, in MS, Sorriso, Campo Novo de Parecis and Primavera do Leste, in MT, Barreiras, in BA, Balsas, in MA, Uruçuí, in PI, Pedro Afonso, in TO, Unaí, in MG, Campo Mourão and Londrina, in PR, Cruz Alta, Ijuí and São Luiz do Gonzaga, in RS in the harvests of the years 2017/18, 2018/19 and 2019/20 were described in Graph 2.

Graph 2. The production cost of transgenic soybeans per hectare (US$/ha) in the first harvest in the main producing regions in Brazil.



Source: The data were obtained by Conab (2020).

The highest production costs per hectare observed in the 2017/18 crop were in Brasília - DF, with US$ 491.24 and Primavera do Leste - MT, with US$ 464.27. In the 2018/19 and 2019/20 harvests, there was an increase in each subsequent crop and remained the same as the highest costs observed in the 2017/18 crop. In the 2018/19 and 2019/20 harvests, the Brasília - DF region obtained a production cost of US$ 512.92 and US$ 562.82 and in Primavera do Leste - MT, with a cost of US$ 482.39 and US$ 537.10, respectively.

Note with the results presented in Mato Grosso, the transgenic cultivation presented higher costs concerning the conventional one. According to Silva et al. (2019), the average production cost of transgenic soybeans is 5.30% lower than the cultivation with conventional soybeans, with no significant differences related to the production cost, making conventional soybeans more profitable considering the bonus.

Marquesa et al. (2012) analyzed four types of properties in the region in the municipality of Rio Verde - GO observed the fluctuation in production costs, which ranged from US$ 250.22 to US$ 328.42 per hectare, concluding that several factors can influence both production costs and prices commodities, showing no direct relationship.

The soybean-producing regions with the lowest production costs were Campo Mourão - PR, with US$ 261.23 and São Luiz Gonzaga - RS, with US$ 264.82. In the subsequent harvest, in 2018/19, the same regions of the previous harvest remained with the lowest costs,

with São Luiz Gonzaga - RS presenting a cost of US$ 268.34, with a lower cost of US$ 0.12 concerning Campo Mourão - PR. In the 2019/20 harvest, the region of Campo Mourão - PR showed a significant increase in cost, leaving the position to Ijuí-RS with US$ 304.21, with São Luiz Gonzaga - RS maintaining the lowest production cost with US$ 301.10.

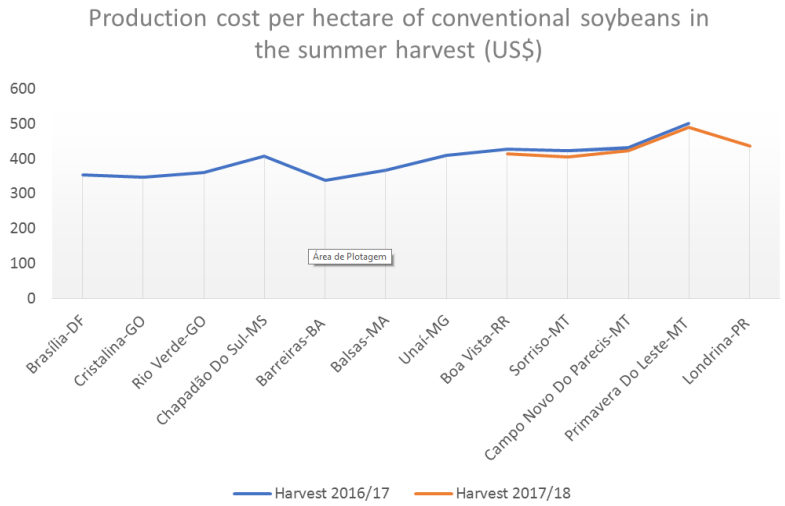
When comparing the costs obtained in the survey, according to Menegatti & Barros (2006), the cost of production with field data in the state of MS, was US$ 235.39 in the 2004/05 crop of transgenic soybeans.

The production cost increased significantly, due to the increase in technologies in the field (Artuzo et al., 2018). In the state of PR, conventional soy had an operating cost higher than that of transgenic soy, ranging from US$ 8.62 ha^{-1} to US$ 13.00 ha^{-1} (Hirakuri, 2013).

The comparison of the lowest production costs between conventional and transgenic soy is notorious, the differences reside in the technology incorporated in the seed and less need for labor in transgenic cultivation, which in total, the cost was 14.8% lower for the cultivation of transgenic soybeans (Menegatti & Barros, 2006).

The costs of conventional soybean production per hectare in the summer harvest in the municipalities of Brasília, DF, Cristalina and Rio Verde, GO, Chapadão do Sul, MS, Barreiras, BA, Balsas, MA, Unaí, MG, Boa Vista, in RR, Sorriso, Campo Novo de Parecis and Primavera do Leste, in MT and Londrina, in PR in the 2017/18 and 2018/19 harvests were described in Graph 3.

Graph 3. Cost of conventional soybean production per hectare (US$/ha) in the summer harvest in the main producing regions in Brazil.



Source: The data were obtained by Conab (2020).

The highest production costs per hectare observed in the 2016/17 harvest were in Primavera do Leste - MT, with US$ 500.81, which in the subsequent year, in 2017/18 obtained a reduction in cost, to US$ 487.97, but is still positioned among the highest cost among the analyzed regions.

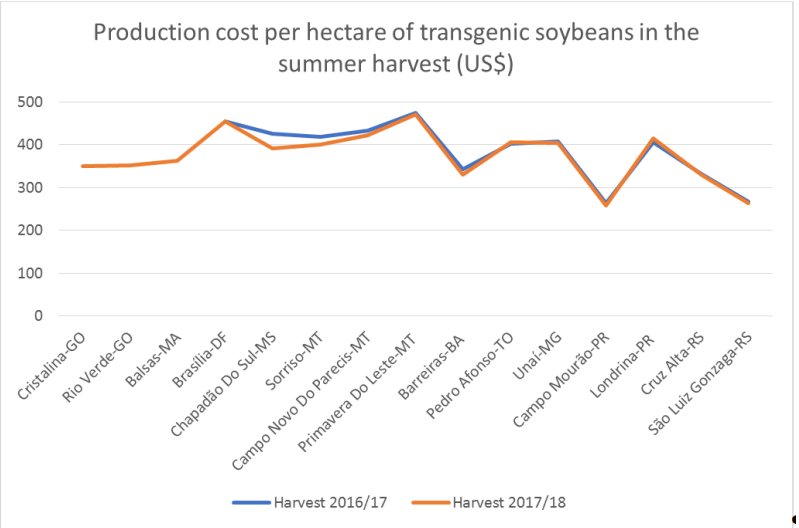
In the work of Alves et al. (2017), when analyzing the production costs of twenty-four producers in the cities of Amambaí - MS, Sete Quedas - MS, Iguatemi - MS, Paranhos - MS, Eldorado - MS and Mundo Novo - MS, four in each city, obtained an average cost of US$ 385.69 per hectare.

In the 2016/17 harvest, the lowest production cost was observed in the region of Barreiras - BA, with US$ 337.63, and it is not possible to obtain results from the subsequent harvest in this region and 2017/18, in Sorriso - MT, with the cost of US$ 404.86.

In Cafelândia - PR, in the work of Hirakuri (2010) he observed the production cost of US$ 309.62 and concluded that the production was highly viable, in the 2008/2009 harvest and for it to be economically sustainable, it was estimated that the crop should reach a yield of 2,521.50 kg ha^{-1}, which corresponds to 77.82% of the expected productivity in the region.

The costs of conventional soybean production per hectare in the summer harvest in the municipalities of Cristalina and Rio Verde, in GO, Balsas, in MA, Brasília, in DF, Chapadão do Sul, in MS, Sorriso, Campo Novo de Parecis and Primavera do Leste, in MT, Barreiras, in BA, Pedro Afonso, in TO, Unaí, in MG, Campo Mourão and Londrina, in PR, Cruz Alta, and São Luiz do Gonzaga, in RS in the 2017/18 and 2018/19 harvests were described in Graph 4.

Graph 4. The production cost of transgenic soybeans per hectare (US$/ha) in the summer harvest in the main producing regions in Brazil.



Source: The data were obtained by Conab (2020).

The highest production costs per hectare observed in the 2016/17 and 2017/18 harvests were in Primavera do Leste - MT, with US$ 474.30 and US$ 470.21, respectively, after the Brasília - DF region, with US$ 453.75 and US$ 455.00.

The regions with the lowest production costs in the 2016/17 and 2017/18 crops obtained in Campo Mourão - PR, the costs of US$ 264.00 and US$ 258.37, and São Luiz Gonzaga-RS with US$ 266.78 and US$ 263.61, respectively.

Machado et al. (2014), when analyzing the cost of transgenic soybean production in Cascavel - PR, it obtained a cost of US$ 268.67 per hectare, being very similar to that observed in Campo Mourão - PR. Besides, the author observed a return of 188.53% on the property, revealing its economic viability.

In Cafelândia - PR, in the work of Hirakuri (2010) observed the cost of production of US$ 292.07, with the profitability of 28.69%. In the work of Hirakuri (2013) observed in Campo Mourão - PR, a production cost that ranged from US$ 314.75 to US$ 344.29 in the 2013/14 harvest.

The high cost of soybean production due to the use of agricultural technologies, coupled with the fluctuation in the market price of products, can lead to loss of profits or activities. Knowledge of crop production costs is effective for controlling agricultural activities since it is possible to create strategic planning in the acquisition of inputs (Artuzo et al., 2018). For the producer, the calculation of production costs is a necessary tool in the analysis of cost behavior to assist him in making decisions regarding the acquisition of resources and inputs.

4. Conclusions

The highest production cost for conventional soybeans in the first harvest was in Primavera do Leste - MT, subsequently Londrina and Ponta Grossa, both in PR. The lowest production costs were in Sorriso - MT and Boa Vista - RR.

The highest production cost for transgenic soybeans in the 1st harvest was in Brasília - DF, in sequence, Primavera do Leste - MT. The lowest production costs were in Campo Mourão - PR and São Luiz Gonzaga - RS.

The highest production cost for conventional soybeans in the summer harvest was in Primavera do Leste - MT and the lowest cost in Barreiras - BA, and Sorriso - MT.

The highest production cost for transgenic soybeans in the summer harvest was in Primavera do Leste - MT, and Brasília - DF. The lowest costs were in Campo Mourão - PR and São Luiz Gonzaga-RS.

The region of Primavera do Leste - MT demonstrated a region with a high cost of production in comparison with other producing regions. The lowest costs varied between several regions, depending on the cultivation system employed.

The production of transgenic soybeans proved to be the most profitable and promising option at the lowest production cost concerning the cultivation of conventional soybeans.

With this study at the national level, we can get an overview of costs. Thus, it is important to conduct a regional study to analyze the costs of each region in a more descriptive manner, as well as a new technological resource that can influence production costs.

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