Producing soybean seed for your own use is an economical option for rural producers?

Produzir sementes de soja para uso próprio é uma opção econômica para os produtores rurais?

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ABSTRACT

The cost of seeds in soybean production is high. Looking for alternatives to reduce expenditure on this input is interesting from an economic point of view. The aim of this study was to measure the cost of producing soybean seed on the farm itself and to carry out an economic analysis of this activity in comparison with certified seed. The case study was carried out on a farm located in the municipality of Jataí-GO. The variable and fixed costs and the total operating cost of four materials (CZB32, CZB43, 73i75, Foco and Bônus) were determined in four parts: sowing and handling, harvesting, post-harvesting and administration. In the end, there was a high production cost for saved seeds, but their average total cost was lower than certified seeds and they were financially profitable for the rural company, as they had lower costs and greater savings for the rural producer. The average saving generated by self-production was R$10,351.70 bigbag-1 compared to certified seed. After being produced, they were sown in the 2022/2023 harvest. However, for this study, some saved seeds proved to be economically viable. However, others had low final yields, which meant that the decision point between using one or the other was close, making saving unfeasible. Investments in both handling and post-harvest are needed to increase the agronomic efficiency of saved seeds and make them more economically interesting for producers.

Keywords: cost of production, Glycine max L., profitability, saved seed.

1 INTRODUCTION

Soybean is one of the main agricultural crops produced in Brazil, and its economic value is high. The gross domestic product of the soy and biodiesel production chain was R$673.7...
billion in 2022, which represented 27% of Brazilian agribusiness, generating around 2.05 million jobs throughout this economic system (CEPEA; ABIOVE, 2023).

In the 2021/22 harvest, Brazil was the largest soybean producer in the world, with a production of close to 135 million tons, which represented 11.6 and 192.2% more than the United States and Argentina, the second and third largest producers of the oilseed on the planet, respectively (FAO, 2023). This high production comes from the use of modern inputs and technology in the production process. These include the use of seeds with high physiological potential, high production standards and biotechnology to control pests and diseases.

However, the cost of these materials is high and affects the cost of producing the crop. As a result, many producers are looking to produce their own seed in order to reduce their costs with this production resource (CASTRO et al., 2006). Some authors advocate the need to use high quality seeds with good germination and vigor standards so that areas don’t need to be replanted, which would further increase production costs (DARTORA et al., 2012; RAMPIM et al., 2016). Others report that certified seeds, due to their high physiological potential, contribute directly to increases in productivity (FESSEL et al., 2010). However, it is estimated that in 2016 in Brazil there were approximately seven million hectares of soya planted with non-certified seeds, equivalent to 20 to 25% of the total market. In the same study, it is projected that, by 2025, the soybean area will be 42 million hectares, making the area of non-certified soybean seeds approximately 10 million hectares (ABRASEM, 2016).

In Brazil, this modality is supported by Law 10.711/2003, which provides for the national seed and seedling system, and article 7 of which establishes the national register of seeds and seedlings within the Ministry of Agriculture, Livestock and Supply (PRESIDÊNCIA DA REPÚBLICA, 2023). MAPA published ordinance 538/2022, which regulates the production and use of seeds and seedlings. In Decree 10.586/2020, which regulates this law, there are several articles and sections that regulate the use of saved seeds, including infractions and applicable penalties (MAPA, 2023). In some countries, such as the United States, it is illegal to produce saved seed. In Paraguay, however, producers who produce their own seed must pay royalties and declare the amount saved, as is the case in Brazil (SILVA et al., 2021).

One of the concerns with the production of saved seed for use in the production of the next crop is its processing and storage. Soybeans have physiological characteristics that make them prone to deterioration and if harvesting and post-harvesting are inadequate, there is a risk
of increased deterioration of the materials due to poor processing and storage of this seed (SOARES, 2003).

On the other hand, seed produced on the farm itself can bring economic gains for rural producers, as the cost of certified seed is a large part of the crop's operating costs. In the last 12 years, it has accounted for an average of around 14% of the operational cost of production (CONAB, 2023), which is a considerable amount. However, yield is a determining factor in profitability, as it affects gross revenue. A reduction in yield can lead to lower revenue and, even at a lower cost, a reduction in final revenue (MYAMOTO, 2009).

The aim of this study was therefore to measure the cost of producing soybean seed on the farm itself and to carry out an economic analysis of this activity in comparison to certified seed. The name given to this type of production is saved seed, which consists of using part of the crop's production as seed for the next harvest.

2 MATERIAL AND METHODS

This research was carried out by means of a case study, the methodology of which is a specific guide for researchers who wish to delve deeper into a certain aspect, taking into account the context and differences. It provides a solid basis for collecting, analyzing and interpreting data in order to have a comprehensive and in-depth understanding of said case under study (GERRING, 2019). It can be a person, a group, an organization, a community or any singular entity that is the object of study (BROWN, 2008).

A case study is based on the following fundamental principles: a) depth and detail, where the case study seeks to explore specifics in depth; b) contextualization, which deals with understanding the context; c) multiple sources of data involving the collection of data from various sources, such as interviews, consultations, documents and records, to obtain a complete picture of the case; d) qualitative analysis, emphasizing the interpretation of data rather than quantitative measures (YIN, 2005; GERRING, 2019).

The stages that a case study goes through are: a) case selection, where the researcher must carefully choose the case that best aligns with the research objectives and is guided by criteria of relevance, accessibility and representativeness; b) data collection, involving obtaining information about the case through methods such as interviews, observations, analysis of documents and records; c) data analysis, the stage in which the data collected is analyzed to
identify patterns, trends and relevant themes; and, d) case report, the stage of describing the context, methods, results and conclusions. The latter should be clear and accessible, allowing other researchers to evaluate and understand the research (EISENhardt, 1989; Gil, 2002).

The methodology used in this work was a case study with data collected in the field and document analysis using the company's internal control reports, stored in management software. It was also exploratory and descriptive with a qualitative and quantitative approach.

This case study was conducted at a rural grain-producing company located in the municipality of Jataí-GO (-17º22'01"S; -51º57'23"W and 957 meters above sea level). The stages for producing saved seed on the farm are shown below (Figure 1). The cost spreadsheet was drawn up based on each of the four stages for producing the farm's own seed.

![Figure 1 - Scheme for the production of farm-saved seed.](image)

The sowing and handling phase ranges from the purchase of inputs to the desiccation of the soybeans in the field to start harvesting. Initially, the soil was analyzed and sampled at a depth of 0 to 20 cm for physical and chemical characterization, containing: sand, silt and clay: 27.7; 7.7 and 64.6%, respectively; pH (CaCl₂): 5.5; Ca, Mg, Al³⁺: < 0.1 cmolc dm⁻³; P, K, S, Bo, Cu, Mn and Zn: >37.0; 50.0; 12.0; 0.3 0.9; 20.0 and > 2.5 mg dm⁻³, respectively; CTC: above 10.2 cmolc dm⁻³ and V: 60.0%.

Sowing for the production of the seed itself took place in mid-December 2022, shortly after the soybean harvest. The cultivars used were CZ 48B32, CZ 37B43, FOCO, Bônus and DM 73i75 IPRO. The spacing between rows was 0.45 meters, in no-till. The following products were applied in the sowing furrow: inoculant composed of Bradyrhizobium japonicum bacteria (SEMIA 5079 and SEMIA 5080), at a dose of 500 mL ha⁻¹, organo-mineral fertilizer (Composition: 3.0% N, 3.7% TOC, 1.0% P2O5, 1.0% K2O, 1.3% Cu, 5.5% Mn and 2.3% Zn. Density: 1.25 g/cm³), at a dose of 200 mL ha⁻¹ and Thiamethoxam+Lambada Cyhalothrin (141+106 g L⁻¹ a.i.), at a dose of 300 mL ha⁻¹.
Before sowing, the seeds were treated with the following products: Thiamethoxan (600 g L^{-1} a.i.), at a dose of 100 ml 100 Kg seed^{-1}, Lambda-Cyhalothrin+Chlorantraniliprole (50+100 g L^{-1} a.i.), at a dose of 150 ml 100 Kg seed^{-1}, Carbendazim+Tiram (150+350 g L^{-1} a.i.), at a dose of 200 ml 100 Kg seed^{-1}. The bioregulators applied: Mg+S+Fe+Zn (12.3+35.7+22.1+24.6 g L^{-1}), at a dose of 100 ml 100 Kg seed^{-1} and polymer, at a dose of 100 ml 100 Kg seed^{-1}. Finally, the biologicals: nematicide *Paecilomyces lilacinus*, Isolate Uel Pae 10 (Minimum 7.5x 10^9 CFU/g of product - 300 g Kg^{-1}), at a dose of 75 g 100 Kg seed^{-1} and *Trichoderma harzianum*, Isolate IBLF 006 (1 x 10^10 CFU/g of product - 300 g Kg^{-1}), at a dose of 75 g 100 Kg seed^{-1}.

Fertilization was carried out in two stages. The first was done before sowing, using 100 kg ha^{-1} of the fertilizer 11-52-00 (MAP - monoammonium phosphate). The top dressing was carried out when the plant was at V3-V4 with the fertilizer KCl (potassium chloride), at a dose of 100 Kg ha^{-1}. Both fertilizer distributions were carried out using a solids distribution machine.

Foliar fertilization was carried out with the following products: Nitroleo (21% N - density of 1.2 Kg L^{-1}) at a dose of 400 mL ha^{-1}, Xiflon Boro Max (Bo+Mo) at a dose of 200 mL ha^{-1}, Aller Biw (15% P2O5) at a dose of 40 mL ha^{-1}, Genium Plus (Mo+Co+Zn+S+polymers) at a dose of 300 mL ha^{-1} and Manphós (N+P+S+B+Cu+Mn and Zn) at a dose of 1 L ha^{-1}.

Chemical pesticides were used to control pests and diseases when necessary due to the emergence of conditions that led to economic damage. The insecticides used were: Acetamiprid+Bifenthrin (250+250 g Kg^{-1} a.i.), at a dose of 200 g ha^{-1}, Lambda-Cyhalothrin+Chlorantraniliprole (50+100 g L^{-1} a.i.), at a dose of 90 mL ha^{-1} and Abamectin (18 g L^{-1} a.i.), at a dose of 480 g ha^{-1}. The fungicides used on the crop were: Picoxystrobin + Benzovindiflupir (150+50 g L^{-1} a.i.), at a dose of 600 mL ha^{-1}, Fluxapiroxad + Pyraclostrobin (167+333 g L^{-1} a.i.), at a dose of 300 mL ha^{-1}, Azoxystrobin+Benzovindiflupir (300+150 g Kg^{-1} a.i.), at a dose of 200 g ha^{-1} and Difenoconal+Ciproconazole (250+150 g L^{-1} a.i.), at a dose of 300 mL ha^{-1}. For weed control, post-emergence applications were made with potassium gliphosate (620 g L^{-1} a.i.) at a dose of 2.8 L ha^{-1}, chloransulan-methyl (840 g Kg^{-1} a.i.) at a dose of 48 g ha^{-1} and haloxyfop-R-methyl + diethylene glycol monoethyl ether (540 + 531 g L^{-1} a.i.) at a dose of 140 mL ha^{-1}.

At the harvest stage, which took place in April 2022, the seeds obtained were sent to the post-harvest stage, which included processing and storage. During the processing phase, the seeds were cleaned and sorted. After this, the saved seeds were stored for 7 months on the farm.
itself, in big bags, in an unrefrigerated environment, inside a closed shed, with a cement floor, a height of 6 meters and zinc roof tiles, waiting to be used in the 2022/2023 summer harvest.

In order to estimate the costs of own seed, production costs were collected and estimated. The data obtained is secondary and the random variables are continuous from uncontrolled experiments (HILL et al., 2003), because they were obtained as they occurred and were recorded and served as the basis for calculating production costs, which were divided into variable and fixed expenses.

Variable expenses (DV) are those that are directly involved with production, such as the cost of pesticides, seeds, fertilizers, operating machinery and equipment and vehicles, technical assistance, Funrural, financial charges and others (CASTRO et al., 2006). These expenses have values that can change in the short term and, for this reason, they need to be replenished every production cycle (VALE; RIBON, 2000).

Fixed expenses (FO) are those that comprise disbursements that do not change in the short term, such as salaries for employees, management, family labor and the owner, as well as depreciation (CASTRO et al., 2006). In addition to this, there are social security costs and insurance for machinery and vehicles and their taxes.

Depreciation of machinery and equipment was obtained using the straight-line depreciation method (da), in R$ ha⁻¹ (REIS et al. 2001). Calculated using the following expression: \[ da = \frac{Vi - Vf}{T / ha} \]
where \( Vi \): initial value of the asset and \( Vf \): scrap value, both in reais; \( T \) is the useful life of the asset, in years, and \( ha \) is the amount of land used in the company's soybean production process in the agricultural year.

The fixed and variable expenses make up the operating cost figures for producing the seed on the farm itself. The sum of the fixed and variable costs made it possible to determine the total operating cost (TOC). Adding the alternative cost of the factors to the TOC results in the total cost of production (TC). The alternative cost of land (land remuneration) was set at 20 bags of soybeans per hectare, which is the value of land for rent in the region.

Thus, when comparing the CT of the saved seed (CTss) with the total cost of the certified seed (CTsc), which is its own commercial value, and it is observed that CTss<CTsc, it can be said that there was a financial gain for the farm's business. The value of the certified seeds was obtained from the market in the municipality of Jataí-GO.
Once the cost of the saved seeds had been established, they were sown in the 2022/2023 summer crop in October 2022. The cultivars CZB32, CZB43, FOCO and DM 73i75 were sown on the farm itself. The Bonus plot was completely discarded and sold as grain. The sowing spacing was 0.45 m between plants.

Before going into the field, the materials were treated chemically and biologically with phytosanitary products (fungicides, nematicides and insecticides), inoculants and adjuvants. The biofungicide was *Trichoderma harzianum* Isolate IBLF 006 (1 x 1010 CFU/g of product - 300 g Kg⁻¹), at a dose of 50 g 100 Kg seed⁻¹ and the fungicide Carbendazim+Tiram (150+350 g L⁻¹ a.i.), at a dose of 300 mL 100 Kg seed⁻¹. The nematicide used was *Paecilomyces lilacinus*, Isolate Uel Pae 10 (Minimum 7.5x 109 UFC/g of product - 300 g Kg⁻¹), at a dose of 50 g 100 Kg seed⁻¹. The insecticides were Chlorantraniliprole (200 g L⁻¹ a.i.), at a dose of 50 mL 100 Kg seed⁻¹ and Thiamethoxan (600 g L⁻¹ a.i.), at a dose of 100 mL 100 Kg seed⁻¹. The inoculant used was *Bradyrhizobium japonicum* (SEMIA 5079 and SEMIA 5080), at a dose of 100 mL 100 Kg seed⁻¹. And finally, the bioregulators: Mg+S+Fe+Zn (12.3+35.7+22.1+24.6 g L⁻¹), at a dose of 100 ml 100 Kg seed⁻¹ and polymer, at a dose of 100 mL 100 Kg seed⁻¹. All the management of the soybean crop followed what was recommended to achieve high yields.

For the economic analysis of soybean production with saved seed, in the 2022/23 harvest, the crop yield was first calculated with each material used, to determine the gross income (RB), given by the expression: \( RB = P_{soja} \times Y \), where \( P_{soja} \): soybean price at the time of sale, in R$ sack⁻¹, and \( Y \): yield obtained from sowing the saved cultivar, in sacks ha⁻¹. Next, the net operating income (RLO) was estimated, in R$ ha⁻¹, which is the result of the difference between the RB and the cost of the saved seed plus royalties (Css), given by: \( RLO = RB - Css \). The best result will be the one with the highest RLO when using saved seed, and it can be concluded that the remaining amount will be used to cover the cost of the investments made in the crop.

Another point comes from the economic decision point, which was used to adopt saved seed over certified seed, which occurs when the RLO of the former is higher than that of the latter (\( RLO_{ss} > RLO_{sc} \)). Thus, there is a production leveling point with certified seed (Yeqsc) that makes it more interesting than saved seed, which is given by the expression: \( Y_{eqsc} < \{ RB_{ss} + (Csc - Css) \} / P_{soja} \), where: \( Y_{eqsc} \): soybean production using certified seed, in bags ha⁻¹, which will make it more economically interesting than using saved seed; \( RB_{ss} \): gross revenue obtained from the production of saved seed, in R$ ha⁻¹; \( Csc \): production cost of the certified seed used in
the 2022/2023 harvest, in R$ ha\(^{-1}\); \(\text{Css}\): production cost of the saved seed, plus royalties, used in the 2022/2023 harvest, in R$ ha\(^{-1}\); and \(\text{Psoja}\): price of a sack of soybeans on the market at the time of commercialization, which for this study was R$159.30 sack\(^{-1}\).

3 RESULTS AND DISCUSSION

The production of saved soybean seed has a very high operating cost (TOC) and total cost (TC), due to the various inputs and services that are incorporated into the production process and observed by the values of the variable and fixed costs in the production stages, as well as with the alternative use, which are the remunerations of land and fixed capital (Table 1).

<table>
<thead>
<tr>
<th>Expenditure items</th>
<th>CZ 37B43</th>
<th>CZ 48B32</th>
<th>DM 7375</th>
<th>FOCO</th>
<th>Bônus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sowing and handling</td>
<td>2,707.27</td>
<td>2,497.38</td>
<td>3,028.02</td>
<td>2,331.41</td>
<td>2,465.15</td>
</tr>
<tr>
<td>Harvesting:</td>
<td>164.21</td>
<td>138.92</td>
<td>154.18</td>
<td>153.41</td>
<td>129.83</td>
</tr>
<tr>
<td>Post-harvest:</td>
<td>5,626.18</td>
<td>4,226.44</td>
<td>5,092.95</td>
<td>5,058.32</td>
<td>3,724.87</td>
</tr>
<tr>
<td>Administration</td>
<td>1.36</td>
<td>1.36</td>
<td>1.36</td>
<td>1.36</td>
<td>1.36</td>
</tr>
<tr>
<td>Variable expenses (DV):</td>
<td>8,499.02</td>
<td>6,864.10</td>
<td>8,276.50</td>
<td>7,544.50</td>
<td>6,321.21</td>
</tr>
<tr>
<td>Sowing and handling</td>
<td>43.47</td>
<td>43.47</td>
<td>43.47</td>
<td>43.47</td>
<td>43.47</td>
</tr>
<tr>
<td>Harvesting:</td>
<td>94.19</td>
<td>94.19</td>
<td>94.19</td>
<td>94.19</td>
<td>94.19</td>
</tr>
<tr>
<td>Post-harvest:</td>
<td>374.44</td>
<td>374.44</td>
<td>374.44</td>
<td>374.44</td>
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</tr>
<tr>
<td>Administration</td>
<td>201.87</td>
<td>201.87</td>
<td>201.87</td>
<td>201.87</td>
<td>201.87</td>
</tr>
<tr>
<td>Fixed expenses (DF):</td>
<td>714.95</td>
<td>714.95</td>
<td>714.95</td>
<td>714.95</td>
<td>714.95</td>
</tr>
<tr>
<td>TOC</td>
<td>9,213.98</td>
<td>7,579.06</td>
<td>8,991.46</td>
<td>8,259.45</td>
<td>7,036.17</td>
</tr>
<tr>
<td>Land remuneration</td>
<td>1,530.00</td>
<td>1,530.00</td>
<td>1,530.00</td>
<td>1,530.00</td>
<td>1,530.00</td>
</tr>
<tr>
<td>Fixed capital remuneration</td>
<td>359.64</td>
<td>359.64</td>
<td>359.64</td>
<td>359.64</td>
<td>359.64</td>
</tr>
<tr>
<td>TC</td>
<td>11,102.62</td>
<td>9,468.70</td>
<td>10,881.10</td>
<td>10,149.09</td>
<td>8,925.81</td>
</tr>
</tbody>
</table>

Source: Research data.

According to the data, 90.8% of the total operating cost comes from spending on inputs that are directly linked to production. Variable expenses were the most significant and most costly in the production of sage seed (CASTRO et al., 2006). The agrochemicals used to treat the seed account for around 10.0% of operating costs.

Post-harvest costs (processing and storage) were the most significant. This phase accounted for well over half of the TOC, at around 62.0%. This stage requires good management on the part of the administrator, as its operation can be significant in affecting the economic viability of the activity. Good processing and storage are vital for maintaining the health and physiological potential of the seeds (VILELA; PERES, 2004). Poor management of this phase can lead to a reduction in reserve constituents, chemical changes, enzymatic alterations and an
increase in the presence of phytopathogenic microorganisms and even larger animals such as rodents.

The need for greater efficiency at this stage drives up costs. Maintaining seed quality, especially physiological quality, with high germination and vigor, means that the farm needs to monitor and invest in the entire production cycle. An example in the research was the very treatment of the seed that will be taken to the production field, which causes these costs to rise considerably.

Fixed costs, on the other hand, were not so significant in the composition of the COT, amounting to almost 10% of it. Operating and management salaries accounted for a large part of the value.

Royalty payments made to the company that owns the technology were not taken into account, despite being a fixed amount for each hectare sown, because the amount was levied on the area sown. This area must be informed before cultivation and the payment took place from July to December, in accordance with the company's regulations. Thus, the cost of royalty increased the cost of the seed when it was sown and was included in the soybean expenses spreadsheet for the 22/23 harvest.

The production of saved soybean seeds showed different yields and costs for the cultivars (Table 2). Cultivar CZ 37B43 had the highest yield among the others and Bônus had the lowest yield.

Table 2 - Average total operating cost (TOCMe) and average total cost (TCMe) of saved seed (in R$ BB⁻¹), production values (in BB*) and financial gain generated with saved seed compared to certified seed** (in R$ ha⁻¹).

<table>
<thead>
<tr>
<th>Items</th>
<th>CZ 37B43</th>
<th>CZ 48B32</th>
<th>DM 73i75</th>
<th>FOCO</th>
<th>Bônus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>4,09</td>
<td>3,68</td>
<td>3,51</td>
<td>4,01</td>
<td>2,81</td>
</tr>
<tr>
<td>TOCMe</td>
<td>2,251,60</td>
<td>2,057,03</td>
<td>2,558,43</td>
<td>2,062,20</td>
<td>2,503,95</td>
</tr>
<tr>
<td>TCMe</td>
<td>2,713,36</td>
<td>2,569,89</td>
<td>3,096,10</td>
<td>2,534,00</td>
<td>3,176,42</td>
</tr>
<tr>
<td>Gain</td>
<td>10,786,64</td>
<td>10,930,11</td>
<td>11,498,90</td>
<td>8,231,33</td>
<td>7,653,58</td>
</tr>
</tbody>
</table>

* BB: bigbag, contains 5,000,000 seeds and its weight varies according to the weight of each seed; ** Average price of certified seed surveyed in the Jataí-GO market.

Source: Data calculated by the author.

In terms of earnings, it was observed that all the saved seeds had an average production cost well below the value of the certified seed, which ended up generating a financial gain for the producer. The best result was with the DM 73i75 cultivar, which resulted in greater savings.
for the rural company. The positive point was that all possible expenses were taken into account, showing the positive reality of producing saved seed.

This difference between the value of a bigbag of saved and commercial seed can give the false illusion that this activity is profitable. Seed is just one item that makes up the total cost of production. However, you have to look at the result, which is the production obtained from sowing the saved seed and the final yield you will get. The decision point, or leveling point, will shed light on the issue.

In order to answer the question of the economic efficiency of the saved seeds, the materials were taken to the production field and sown on the farm. With the exception of Bonus, which was discarded and sold as grain. Its germination and vigor rates were below those recommended, reducing its physiological potential as indicated by the tests, making it unfeasible to sow (Figure 2).

Figure 2 - Germination (A) and vigor (B) indices of own seeds produced in the rural company evaluated on 01/June, 14/July and 05/September, in the year 2022.

Seeds with vigor below 80% should be discarded. Germination and vigor rates well below those indicated cause morphological and physiological changes in the seed, compromising the final yield of the crop (BRASIL, 2013; MASON, et al., 2017; MACULAN et al., 2021), which compromises final profitability. The Bonus cultivar should have been discarded as seed and marketed as grain, before being processed and stored, due to the high post-harvest costs.

On the other hand, when producers aim to produce their own seed, they should pay attention to the germination and vigor indices, which should be worked on while still in the field.
so that their values are high and there is a good response as saved seed. The fact is that grain producers are not seed producers. Good seed starts with taking care of the crop in the field in order to have quality seed.

Another factor that may have compromised the germination and vigor rates of the saved seeds was the storage conditions. They were stored in an environment without temperature and humidity control, i.e. they were exposed to heat, lack of ventilation and pests and fungi, which adversely affected the final quality of the material. Factors such as temperature, relative humidity and seed water content have a major influence on maintaining quality during storage (CARVALHO; NAKAGAWA, 2012). The oil content of the seeds can also be a crucial factor in maintaining their quality. Fatty acids are susceptible to oxidation, which leads to rancidity and can reduce the useful life of the material (GOLDFARB; QUEIROGA, 2013). Investment in cold rooms can be an interesting factor in improving the physiological standard of seeds. However, the high value of the investment can contribute to it not being implemented on farms, preferring to take the risk with material of lower physiological quality.

The presence of storage fungi, mainly of the genera Aspergillus spp. and Penicillium spp. (CARVALHO; NAKAGAWA, 2012), in soybean seeds also causes a loss of quality and can make the seed unviable. Long periods of storage can reduce the vigor and germination of the material, due to the presence of fungi that appear in the batches, especially those exposed to higher temperatures (RAMPIM et al., 2016).

The appearance of rodents and insects also leads to losses in the production of sage seed. Poor storage exposes the seed to attacks by animals that reduce both the volume and final quality of the material, such as rancidity, fermentation and alteration of the physiological and organoleptic properties of the seeds (GOLDFARB; QUEIROGA, 2013).

After sowing and harvesting, the results of soybean production using own seed (saved) showed that the CZ 37B43 cultivar had the best economic performance among the other materials, as it had a better yield, higher revenue and a better economic result, as it had higher RLT and IL, which indicated a greater surplus to fund new investments (Table 3). It had a leveling point in relation to the certified seed of around 3.3 bags, which indicated that a production above 69.4 bags would make the certified seed more profitable than the saved seed.
Table 3 – Total production values, gross revenue, average total cost of saved seed (TCMes), average total cost of certified seed (TCMec), total net income of saved seed (RLTs), profitability index of saved seed (ILs) and economic equilibrium production of certified seed (Yec), for the cultivars of saved seed grown in the 2022/2023 harvest, in Jataí-GO.

<table>
<thead>
<tr>
<th>Items</th>
<th>Unidades</th>
<th>Variedades</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CZ 37B43</td>
<td>CZ 48B32</td>
</tr>
<tr>
<td>Total production</td>
<td>Kg ha(^1)</td>
<td>3.964</td>
</tr>
<tr>
<td>Gross revenue(^1)</td>
<td>R$ ha(^1)</td>
<td>10.524,42</td>
</tr>
<tr>
<td>TCMes(^2)</td>
<td>R$ ha(^1)</td>
<td>431,02</td>
</tr>
<tr>
<td>TCMec</td>
<td>R$ ha(^1)</td>
<td>960,00</td>
</tr>
<tr>
<td>RLTs</td>
<td>R$ ha(^1)</td>
<td>10.093,40</td>
</tr>
<tr>
<td>ILs</td>
<td>%</td>
<td>95,9</td>
</tr>
<tr>
<td>Yec</td>
<td>Kg ha(^1)</td>
<td>4.163</td>
</tr>
</tbody>
</table>

\(^1\) The price of soybeans at the time of trading was R$ 2,655 Kg\(^{-1}\); \(^2\) TCMes already has the royalties incorporated into the seed.

Source: Calculated by the author.

The production of more than 43,7 sacks of soybeans with the CZ 48B32 cultivar this season would make certified seed more economically interesting than saved seed, making it economically unviable for farmers to use it as seed. As this is a high-yielding cultivar, the use of this material on the farm has not shown an economic return for the rural company. For this reason, producers should always be aware of what might be most interesting at the time of sowing.

It is therefore necessary to emphasize that production with saved seed has advantages, such as a reduction in production costs and control of the input, as it is available to the rural company (MASCARENHAS; BUSCH, 2006). These authors pointed out that because they couldn't save seed in the US, producers there lost control over the production process on their farms. Another positive point was the fact that this study considered all production costs and showed the reality of the costs of this activity on the farm and that it was financially viable for the producer. Manson et al. (2017) concluded that it was ideal not to account for extra expenses in order to obtain a return on this activity.

However, there are disadvantages to this activity, such as the loss of area due to off-season production and the risk of damage to soybean seed production due to pests, diseases or adverse weather conditions. Another visible drawback is the fact that the saved seed is produced on the farm and is not subject to quality control inspections. As a result, it is up to the producer to make sure that the seed produced will have adequate vigor and germination rates to achieve good productivity. One way out of this is the accelerated ageing test, which assesses the physiological potential of the seed batch and which, as Dutra and Vieira (2004) point out, has proved effective in determining the vigor of soybean materials.
4 CONCLUSION

The production of saved soybean seed can be interesting from a financial point of view. However, it is necessary for this material to have good physiological quality, such as germination and vigor, and good health in order to have a good yield at harvest time, in the season in which it was sown. If this doesn't happen, certified seed, because it has high production standards, becomes more economically interesting for the rural company.

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