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A ECONOMIC ANALYSIS OF ANNUAL CROPS SUBJECT TO BIOAGRICULTURAL MANAGEMENT

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ABSTRACT
The growing need for food worldwide causes changes in supply, which is not always concerned with the quality in which this food is being offered to consumers. That said, the concern with producing quality food, aiming at the maximum organic bases and available inputs, combined with the ability to produce one's own bioinputs on the farm, reduces dependence on external inputs, and greater control of production costs within the properties demonstrates a total internal interdependence for the production of food or raw materials. The research aims to evaluate the economic sustainability in the cultivation systems of the most important annual crops in the country; Soybeans, Corn, Wheat and Beans in the use of bioinputs on the farm to obtain a reduction in production costs. Research conducted in the municipality of Chapecó - SC during the 2021/2022 and 2022/2023 harvests. The research design is a factorial (3x6), factor A crop management, factor B different doses of basalt powder for the crops of Corn Harvest, Beans Harvest, Wheat Harvest and Soybean Harvest. Qualitative research on product/dose/target values. Economic results differed between production costing, attractive in scale in R$/ha-¹ in biological management (A) and Bioagricultural (C) in the crops of corn, beans and soybeans. As well as the break-even point, the economic and financial results of the four crops evaluated were equivalent and positive in biological management (A). Significantly positive analysis in the economic indicators of profitability, between the different cultivable managements and doses of basalt powder.

Keywords: Bioagriculture, Bioinputs, Economic Viability.

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INTRODUCTION

The need to meet the increased demand for food consumption has transformed agriculture in recent years with frequent advances, bringing innovation and investment to the area (ARTUZO et al., 2017). Bioagricultural production is a set of actions and management that aim to holistically solve the problems of conventional/chemical agriculture, and much of the research carried out is isolated and requires systemic evaluations of joint control in the phytosanitary and phytopathological efficiency of plants, in addition to all research on the microbiological quality of the soil with the correct use of basalt powder and its remineralizers.

Rock dressing is an alternative used to correct acidity, a source of nutrients and a soil remineralizer, incorporating rock powder together with other minerals, helping to reduce chemical products and environmental impacts. The extended period of action of rock powder mixed with other organic fertilizers, as a complement, generates a reserve of nutrients, favoring the resistance of plants to biotic and abiotic stresses (BRITO et al., 2019). On rural properties, there are entrepreneurship and management factors that are extremely important for social and economic issues. Administrative and productive functions are crucial for farmers, as well as management of production costs in order to set sales prices and plan correct and assertive decisions (FONSECA, 2018).

The economic viability of the enterprise depends on the nature of these variations, associated with the prices of inputs and the product. The harvested volume of a crop that provides maximum economic efficiency may be slightly below the expected yield, but with greater profitability. The analysis of maximum technical and economic efficiency is one of the first steps in determining the optimization of the nutritional efficiency of the use of rock dust in the Western region of Santa Catarina in the lines of fruit and vegetables (HF) and crop plants (LAJÚS, 2021). The adoption of technologies in inputs involving production costs, equipment, labor and agricultural zoning, balanced with the economic factors of production, aims to reduce dependence on imported inputs, from which alternatives such as organic fertilizers become greater factors and attributes of soil fertility than mineral fertilizers (BELLÉ, et al., 2021). Thus, the objective is to evaluate the sustainability of bioagricultural crops within the scope of economic analysis in annual crops (Corn, Beans, Wheat and Soybeans).

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METHODOLOGY

The research design is characterized by its approach in qualitative research; as for the focus, it consists of explanatory research, by identifying the factors that determine phenomena, explaining the reason for things; with regard to the procedures, it consists of experimental research which determines an object of study, selecting variables that influence, defining the forms of control and observation of the effects that the variables produce on the object. The experiment was carried out in the municipality of Chapecó, Marechal Bormann District in the state of Santa Catarina, latitude 27º 10’ 53’’ South and longitude 52º 37’ 49” West. At an altitude of 700 meters above sea level (GOOGLE EARTH, 2022). The experimental area has soil classified as Dystrophic Red LATOSSOIL, with a clayey texture and slightly undulating relief (EMBRAPA, 2013).

The treatments were designed in a factorial scheme (3 x 6), with factor A being crop management, and factor B being different doses of basalt powder, in 3 replicates totaling 54 plots, for the following crops: Corn, Beans, Winter Wheat and Summer Soybeans.

• Area 01 (A) 100% AMTec Bioagrícola Biological Treatment;

Treatments following AMTec Bioagrícola guidelines for positioning the biological products multiplied on the farm. Area for more than 2 consecutive years without using chemical fertilizers (NPK+Micros) in the planting furrow. Use of biological products in 100% of the plots/area to control pests and diseases with AMTec products, biofungicides, bioinsecticides and resistance induction. In the planting furrow (directed jet) use of inoculants and nutrient solubilizers, AMTec Bioagrícola. • Area 02 (B) 100% Chemical Treatment (conventional);

Treatments following the guidelines of the regional cooperative, containing normal chemical fertilization (conventional NPK), according to the crop and the cooperative's guidelines, plus 100% chemical phytosanitary and entomological treatments + foliar nutrition. In this treatment, inoculants are not and have never been used via the planting furrow.

• Area 03 (C) Bioagricultural Treatment – AMTec + Chemical management;

Containing application of fertilizers via the planting furrow (NPK), the same as area 02, but with the addition of AMTec Bioagricultural inoculants and nutrient solubilizers via the planting furrow. Applications of products for pest and disease control interspersed, that is, at least 2 aerial applications of AMTec biologicals, biofungicides, bioinsecticides and resistance/nutrition induction plus 2 chemical fungicides and insecticides. Soil management

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actions and positioning in all treatments and plots were carried out from April to May 2021, applying basalt powder, a filler product (filler powder) 100% below 0.30 mm. Used as a source of Phosphorus, natural Phosphate, a product with 12.10% P_2O_5, plus 13.40% Calcium and other elements, at a dose of 1500 kg/hectare only in the treatments of areas 1 (A) and 3 (C), equal doses applied in the experimental area. In the same period, Calcitic Limestone and Agricultural Gypsum were applied at doses of 3000 kg/hectare and 1000 kg/hectare, respectively. Both according to the soil analysis carried out at that time. In particular, in areas 01 (A) and 03 (C), a source of boron and other elemental constituents called ulexite was applied in a broadcast, together with natural phosphorus powder (same operation), at a dose of 30 kg.ha^{-1}. Before planting the mix, plots were formed with different doses of basalt powder. In area 02 (B), only calcitic limestone and agricultural gypsum were applied, in addition to the formation of different doses of basalt powder.

RESULTS AND DISCUSSION

Production costs prevail in a way that aims to better quantify direct costs established within variable costs, in order to improve the vision of these elements, providing subsidies for optimal decision-making.

ECONOMIC ANALYSIS OF PRODUCTION COST: DOSES AND PRODUCTS OF ANNUAL CROPS

The cost analysis of the production of the four corresponding crops, in the analysis of the variable costs in the composition between the different managements combined with the different doses of basalt powder, exposing the categories that make up the cultural treatments, such as insecticides and bioinsecticides, chemical fungicides and biofungicides, nutrition and the induction of plant resistance.

Thus, Table 1 shows the costs equalized in all treatments, for example, the liming of Calcitic Limestone at a dose of 3 tons/ha-1 cost R$345.00/ha-1. Gypsum at a dose of 1 ton/ha-1 cost R$95.00/ha-1, both used equally in the three treatments. Regarding the costs of natural phosphate powder and Ulexite (source of Boron), both were positioned only in the biological (A) and bioagricultural (C) areas, increasing the cost by R$352.90/ha-1. Winter cover cropping mix cost R$180.00/ha^{-1} in all managements, with these costs divided into the following crops: corn, beans, wheat and soybeans in equal proportions.

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Table 1: Costs of Distribution and Formation of Cover Crop Mix

	FATOR /	Pó de Basalto		Pó de Calcário Calcitíco		Pó de Gesso agrícola		Pó de Fosfato Natural		Ulexita		Semente Mix - Custo de rateio em 4 Culturas		Dose			
CULTURA	TRATAMENTO	Ton.ha	R$/há	Ton.ha	R$/há	Ton.ha	R$/há	Ton.ha	R$/há	Ton.ha	R$/há	kg/há	R$/há	Aplicação 01	PRODUTOS	lts.kg.ha	R$/há
MIX DE COBERTURA	A	0 1 3 5 7 9	0,00 160,00 480,00 800,00 1120,00 1440,00	3	345,00	1	95,00	1,3	286,00	0,03	66,90	50,00	180,00	APLICAÇÃO AÉREA 30 DIAS ANTES DA DESSECAÇÃO	Em solo B. pumillus EM inseto	5 4 4	49,14
MIX DE COBERTURA	B	0 1 3 5 7 9	0,00 160,00 480,00 800,00 1120,00 1440,00	3	345,00	1	95,00	n.a	n.a	n.a	n.a	50,00	180,00	n.a	n.a	n.a	n.a
MIX DE COBERTURA	C	0 1 3 5 7 9	0,00 160,00 480,00 800,00 1120,00 1440,00	3	345,00	1	95,00	1,3	286,00	0,03	66,90	50,00	180,00	APLICAÇÃO AÉREA 30 DIAS ANTES DA DESSECAÇÃO	Em solo B. pumillus EM inseto	5 4 4	49,14

Source: prepared by the authors, 2023.

The different doses of basalt powder cost R$160.00 per ton, and were positioned according to the dose from 1 to 9 tons/ha-¹ and their corresponding cost. There was a specific application of biological products in areas (A) and (C) that cost R$49.14/ha-¹, 13 liters of microorganisms multiplied in the biofactory and applied to the mix 30 days before desiccation. This cost is also absorbed among the four crops within the respective management.

In addition, no synthetic mineral fertilizers or chemical pesticides were used, and there was no soil disturbance, adopting practices that respect the health of the ecosystem. Corn productivity results in both areas were considered satisfactory, even with values lower than the production forecast for the 2022 harvest. The average production cost was significantly lower in areas where regenerative agriculture was adopted compared to data collected on conventional production costs in the state of Mato Grosso do Sul.

Fundamental values must be quantified for financial planning and decision-making by farmers, as they allow them to assess the total cost of implementing and managing corn crops, identify the most relevant inputs in terms of expenses, and consider the cost-benefit ratio of each treatment adopted. In addition, the analysis of these values contributes to the search for more sustainable and efficient practices, aiming at optimizing corn production with less environmental impact and greater economic return.

Table 2 shows the analysis of variable costs and production costs in corn crops for the three treatments and their respective categories of direct costs in crop formation and production. In this sense, Table 2 shows the total costs at R$6,109.58/ha-¹, without considering the variable values of the basalt powder doses used in treatments. This table shows the corresponding costs for area 02 (100% chemical), with a total cost 3.68% lower compared to government data.

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Table 2: Analysis of production costs between management & basalt powder doses & yields (sc/ha) on variable cost items – 2021/202 corn harvest2.

	ÁREA 01 (A)		ÁREA 02 (B)		ÁREA 03 (C)	
	Milho Safra 2021/2022					
CUSTOS VARIÁVEIS (CV) - CUSTEIO DE PRODUÇÃO	R$ p/ ha	R$ p/ saca Venal	R$ p/ ha	R$ p/ saca Venal	R$ p/ ha	R$ p/ saca Venal
		R$ 88,00		R$ 88,00		R$ 88,00
Calagem Calcitíco + Gesso (Todas áreas) Fosfato Natural + Úlexita (área	R$ 198,23	R$ 1,92	R$ 110,00	R$ 1,09	R$ 198,23	R$ 1,81
MIX de Cobertura - (Inverno 2021) - Custo de Rateio 2 anos (4 cultivos)	R$ 45,00	R$ 0,44	R$ 45,00	R$ 0,45	R$ 45,00	R$ 0,41
Sementes + Trat. Semente	R$ 1.162,00	R$ 11,27	R$ 1.162,00	R$ 11,53	R$ 1.162,00	R$ 10,60
Sulco do plantio (solubilizadores e fixadores de nutrientes)	R$ 78,02	R$ 0,75	n/a	n/a	R$ 78,02	R$ 0,71
Adubos Químicos N-P-K + (Micronutrientes) Úreia (Nitrogênio)	n/a R$ 408,76	n/a R$ 3,96	R$ 605,84 R$ 817,52	R$ 6,01 R$ 8,11	R$ 605,84 R$ 408,76	R$ 5,53 R$ 3,73
Herbicida pré-emergentes Herbicida pós-emergentes Herbicida final de ciclo – Dessecante	R$ 74,65 R$ 56,88 -	R$ 0,72 R$ 0,55	R$ 74,65 R$ 56,88 -	R$ 0,74 R$ 0,56	R$ 74,65 R$ 56,88 -	R$ 0,68 R$ 0,52
Inseticidas Químicos Bioinseticidas	n/a R$ 236,00	n/a R$ 2,29	R$ 569,00 n/a	R$ 5,65 n/a	R$ 189,00 R$ 151,98	R$ 1,72 R$ 1,39
Fungicidas Químicos Biofungicidas	R$ 0,00 R$ 147,64	R$ 0,00 R$ 1,44	R$ 84,41 n/a	R$ 0,84 n/a	R$ 84,41 R$ 101,28	R$ 0,77 R$ 0,92
Nutrição Foliar Química Indução de resistência - Nutrição Biológica - Remineralizadores	n/a R$ 48,70	n/a R$ 0,47	R$ 288,00 n/a	R$ 2,86 n/a	n/a R$ 29,80	n/a R$ 0,27
C. S. R. (2,3%) Funrural	R$ 208,71	R$ 2,02	R$ 203,98	R$ 2,02	R$ 221,83	R$ 2,02
CUSTEIO MÉDIO DE PRODUÇÃO	**R$ 2.645,68**	**R$ 25,66**	**R$ 4.017,27**	**R$ 39,86**	**R$ 3.407,67**	**R$ 31,08**
Rendimento Médio sc/há	***103,12ab***		***100,78b***		***109,60a***	
Var. % Custeio Sobre Valor Venal		**29,16%**		**45,30%**		**35,32%**

Doses Pó de Basalto	Rento sc/há	R$ p/ ha	R$ p/ saca Venal	Rento sc/há	R$ p/ ha	R$ p/ saca Venal	Rento sc/há	R$ p/ ha	R$ p/ saca Venal
0	*108,07 aAB*	R$ 2.655,70	R$ 24,57	*102,37 aA*	R$ 4.020,49	R$ 39,27	*108,93 aA*	R$ 3.406,31	R$ 31,27
1	*86,90 bB*	R$ 2.652,85	R$ 30,53	*112,90 aA*	R$ 4.081,80	R$ 36,15	*111,27 aA*	R$ 3.451,05	R$ 31,02
3	*99,23 aAB*	R$ 2.757,81	R$ 27,79	*104,57 aA*	R$ 4.144,94	R$ 39,64	*100,77 aA*	R$ 3.509,80	R$ 34,83
5	*113,53 aA*	R$ 2.866,75	R$ 25,25	*96,13 aA*	R$ 4.207,86	R$ 43,77	*112,43 aA*	R$ 3.613,40	R$ 32,14
7	*110,17 aA*	R$ 2.939,95	R$ 26,69	*93,77 aA*	R$ 4.283,08	R$ 45,68	*106,27 aA*	R$ 3.680,93	R$ 34,64
9	*!00,87 abAE*	R$ 3.001,13	R$ 29,75	*94,97 bA*	R$ 4.365,51	R$ 45,97	*117,93 aA*	R$ 3.784,53	R$ 32,09

Source: prepared by the authors, 2023.

When evaluating the direct production cost, Table 2, the area (B) totaled 4,017.27 R$/ha-¹, approximately 65.75% of the total cost. It is important to evaluate the differences in values between the costs between the managements, with a difference of 1,371.59 R$/ha-¹ between managements (B) more compared to management (A), 34.14% lower than the cost of the area 100% of managements with bioinputs. Bioagricultural management (C) has a cost of R$3,407.67/ha-¹, also a lower value compared to chemical management, however it was R$761.99/ha-¹ higher than biological management (A) due to the positioning of the application of chemical insecticides in replacement of bioinsecticides, an application of chemical fungicide in the tasseling in replacement of the biofungicide used in the biological area and the inoculation of furrow which cost R$78.02/ha-¹ together with the fertilizers. The cost of production is extremely economically attractive, with a total cost of R$5,642.05/ha-¹, as shown in Table 8.

Regarding the market value, biological management (A) represents R$25.66 of the R$88.00 of the sale, followed by bioagricultural (C) with R$31.08 and chemical/conventional (C) with R$45.30. An interesting index to observe is the percentage that they represent 29.16%, 35.32% and 45.30% respectively of the total market value. When analyzing the total costs, Table 73, 74 and 75 in corn crops, the profitability margins (%) decrease as the

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cost of production increases, combined with the decisions made between the different management methods.

The total cost of implementing corn crops for the 2021 harvest was estimated at R$3,311.34/ha-¹. The variable cost corresponded to 91.51% of the total, representing the largest part in the formation of the production cost. Inputs were the main contributors to the formation of this cost, representing 67.16% of the variable cost and 61.46% of the total cost. This was due to the variation in input prices throughout the year, with a large part of the purchases made in the first quarter. The fixed cost, in turn, represented 5.09% of the total cost, with the cost of fixed labor (3.65%) being the main factor responsible for this value. Therefore, the operational cost reached 96.60% of the final production cost for the 2021 harvest (APROSOJA, 2021). Accounting as shown in table 74 of area (B), corn crop corresponding to the 2021/2022 harvest, conventional chemical management costs represented on average 63 to 65% (depending on the basalt powder doses) of the variable cost compared to the total cost. During this period, input costs were high and increased, greatly impacting this administrative distribution. The fixed cost compared to the previous harvest was 4.41%, when comparing area management (A) 5.44% and area (C) 5.39%, this increase occurs due to the percentage adjustment in relation to the total cost, since the total cost of biological and bioagricultural management was lower compared to chemical management (B); however, the fixed cost is the same between both.As doses do pó de basalto conforme o rendimento captado nos diferentes tratamentos, variaram conforme o aumento do custo por tonelada do pó de basalto, mostrando que no manejo biológico (A) a dose de 5 ton/ha-¹ apresenta o melhor fator econômico da rentabilidade determinada neste caso pelos 113,53 sc/ha-¹ e custeio 2.866,65 R$/ha-¹.

In management (B) the best performance is using 1 ton/ha-¹ of basalt powder, obtaining a better yield of 112.90 bags/ha-¹ and costing R$4,081.80/ha-¹. Bioagricultural management (C) doses of 1 to 5 ton/ha-¹ present a yield with a difference of 1.16 bags/ha-¹, with a higher cost of R$162.35/ha-¹ for 5 ton/ha-¹, there is a sales value of R$88.00 per bag, the difference is equivalent to R$60.27/ha-¹, the production cost being higher at 5 ton/ha-¹. Based on this analysis, it is important to consider the sales value, since it represents 68.48% of the R$88.00 per square meter. However, if the sales value were lower, the decision to use 1 ton/ha-¹ of basalt powder would be more interesting. However, the 5 ton/ha-¹ dose presents, in equal relation to management (A), the best dose of the material in order to position the product.

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These data only account for chemical and biological management, which includes seed treatment; a series of inputs are used to ensure the healthy and productive development of crops. The seed treatments applied include Drying Powder, Imidacloprid TS, Thiamethoxam TS and Carbendazin+Tiran, which help control pests and protect seeds from possible damage. Let us see that it is possible to increase sustainability in crops by better positioning the use of bioinputs to reduce and achieve efficient production costs. In this sense, research focused on the use of microorganisms, such as biofertilizers in fertilizing sprays, is essential to achieve sustainable control of pests and diseases in corn crops. These practices, based on ecological principles, can significantly contribute to agricultural productivity in an environmentally responsible manner.

Biofertilizers have been shown to act synergistically with other biological control agents, such as Bacillus thuringiensis and the fungus B. bassiana, reducing the viability of eggs and the survival of larvae of other pests, such as the corn leafhopper. The results obtained provide evidence that the use of biofertilizers can be a sustainable and economically viable way to induce resistance in corn crops, when associated with conventional or chemical management.

In light of the discussion on agroecological transition, farmers often wonder about the efficiency of organic fertilization compared to chemical fertilization, as well as the increase in labor required to carry out fertilization with manure. However, the farmer suggests planting a row of crotalaria between the corn rows, with the aim of demonstrating the viability of polyculture and reducing the need to use herbicides to control weeds. This practice can bring significant benefits, providing greater diversity in the crop and improving soil health and reducing the cost of pre- and post-emergent herbicides.

Table 3 shows the analysis of variable costs and production costs in the bean crop for the three treatments and their respective categories of direct costs in the formation and production of the crop. It presents values in R$/ha^{-1} and R$.sc.venal-1, the value at which the bag of beans was sold at that time. Regarding the costs of basalt powder, the same is presented in detail in yields sc/ha^{-1} in the same database R$/ha^{-1} and R$.sc.venal-1, per dose of basalt powder. In the analysis, the costs of chemical fertilizers (NPK + micro) are not adding to the cost in the area (A) 100% biological in all quantified crops. In the case of beans, the fertilizer costs R$ 1,162.00/ha^{-1} more in managements (B) and (C) with the same yield sc/ha^{-1} in equal statistical significance, equivalent to exactly 7 bags of beans. The production costs in bean cultivation, related to fertilizers and pesticides, had a significant increase. Between the first and the last quarter of 2021, there was an increase of 18.98% in fertilizers and 3.88% in pesticides. Both had this increase in cost due to high demand, scarcity of global supply, high international prices and problems with international logistics (SAA.PR, 2022).

TABLE 3: Production cost analysis between management & basalt powder doses & yields (sc/ha) on variable cost items – 2022 bean second crop

	ÁREA 01 (A)		ÁREA 02 (B)		ÁREA 03 (C)	
	Feijão Safrinha 2022					
CUSTOS VARIÁVEIS (CV) - CUSTEIO DE PRODUÇÃO	R$ p/ ha	R$ p/ saca Venal	R$ p/ ha	R$ p/ saca Venal	R$ p/ ha	R$ p/ saca Venal
		R$ 166,01		R$ 166,01		R$ 166,01
Calagem Calcitíco + Gesso (Todas áreas) Fosfato Natural + Úlexita (área 01 e área 03)	R$ 198,23	R$ 8,84	R$ 110,00	R$ 4,72	R$ 198,23	R$ 8,26
MIX de Cobertura - (Inverno 2021) - Custo de Rateio 2 anos (4 cultivos)	R$ 45,00	R$ 2,23	R$ 45,00	R$ 1,93	R$ 45,00	R$ 1,87
Sementes + Trat. Semente	R$ 766,71	R$ 34,20	R$ 765,09	R$ 32,81	R$ 765,09	R$ 31,87
Sulco do plantio (solubilizadores e fixadores de nutrientes)	R$ 98,41	R$ 4,39	n/a	n/a	R$ 98,41	R$ 4,10
Adubos Químicos N-P-K + (Micronutrientes) Úreia (Nitrogênio)	n/a n/a	n/a n/a	R$ 1.062,00 n/a	R$ 45,54 n/a	R$ 1.062,00	R$ 44,23
Herbicida pré-emergentes Herbicida pós-emergentes Herbicida final de ciclo – Dessecante	R$ 169,95 R$ 71,96 n/a	R$ 7,58 R$ 3,21 n/a	R$ 169,95 R$ 87,20 n/a	R$ 7,59 R$ 3,74 n/a	R$ 169,95 R$ 71,96 n/a	R$ 7,08 R$ 3,00 n/a
Inseticidas Químicos Bioinseticidas	n/a R$ 203,92	n/a R$ 9,10	R$ 655,62 n/a	R$ 28,11 n/a	R$ 313,50 R$ 101,96	R$ 13,06 R$ 4,25
Fungicidas Químicos Biofungicidas	n/a R$ 196,42	n/a R$ 8,76	R$ 301,73 n/a	R$ 12,94 n/a	R$ 150,86 R$ 113,40	R$ 6,28 R$ 5,43
Nutrição Foliar Química	n/a	n/a	R$ 96,00	R$ 4,12	n/a	n/a
Indução de resistência - Nutrição Biológica - Remineralizadores	R$ 178,57	R$ 7,96	n/a	n/a	R$ 178,57	R$ 7,44
C. S. R. (2,3%) Funrural	R$ 85,60	R$ 3,82	R$ 89,04	R$ 3,82	R$ 91,68	R$ 3,82
Subtotal - CUSTEIO DE PRODUÇÃO	R$ 2.019,71	R$ 90,09	R$ 3.381,63	R$ 145,32	R$ 3.377,61	R$ 140,69
Rendimento Médio sc/há	*22,42a*		*23,32a*		*24,01a*	
Var. % Custeio Sobre Valor Venal		54,27%		87,54%		84,75%

Doses Pó de Basalto	Rento sc/há	R$ p/ ha	R$ p/ saca Venal	Rento sc/há	R$ p/ ha	R$ p/ saca Venal	Rento sc/há	R$ p/ ha	R$ p/ saca Venal
0	*17,44 aA*	R$ 2.000,69	R$ 114,72	*19,05 aA*	R$ 3.365,32	R$ 176,66	*19,24 aA*	R$ 3.359,39	R$ 174,60
1	*20,31 aA*	R$ 2.051,61	R$ 101,06	*24,49 aA*	R$ 3.426,09	R$ 139,90	*21,99 aA*	R$ 3.409,89	R$ 155,07
3	*24,85 aA*	R$ 2.148,98	R$ 86,48	*24,77 aA*	R$ 3.507,16	R$ 141,59	*28,60 aA*	R$ 3.515,13	R$ 122,91
5	*25,07 aA*	R$ 2.229,82	R$ 88,94	*25,53 aA*	R$ 3.590,07	R$ 140,62	*28,90 aA*	R$ 3.596,28	R$ 124,44
7	*25,84 aA*	R$ 2.312,76	R$ 89,50	*23,53 aA*	R$ 3.662,43	R$ 155,65	*24,51 aA*	R$ 3.659,51	R$ 149,31
9	*21,05 aA*	R$ 2.374,47	R$ 112,80	*18,56 aA*	R$ 3.723,45	R$ 200,62	*20,82 aA*	R$ 3.725,43	R$ 178,93

Source: prepared by the authors, 2023.

The total production costs of beans in the 2021 harvests were R$3,855.83/ha-¹, with the cost of production being R$3,317.70/ha-¹, 83.06% of the total cost (CONAB, 2021). As shown in Table 74, the analysis of the economic costs of beans in the 2022 second crop shows R$4,285.02/ha-¹, and the cost of production was R$3,255.35/ha-¹, representing 75.97% of the total cost. In other words, the total cost was higher compared to the relative cost indexes presented by Conab, however, the cost of production was lower within the same chemical management (B) in the conventional metric of bean cultivation.

The cost categories are organized by proportional allocations, such as liming and gypsum, plus bean seeds, cover mix and herbicide. The costs of controlling bean pests with chemical insecticides were 3 times higher compared to bioinsecticides among treatments (B) compared to (A). In disease control, these differences were smaller, costing 196.42 R$/ha-1 area (A) of biofungicides against 301.73 R$/ha-1 (B) and intercalated association of applications in management (C) costing 264.26 R$/ha-1.

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The nutritional part of the bean crop was heavily invested through AT ROCK, in the induction of physiological resistance, costing 178.57 R$/ha-1 in both biological and bioagricultural management compared to 96.00 R$.ha-1 in chemical management, but only attributing nutrient sources at the foliar level. The costs of organic production (A) went from 2019.71 R$/ha-¹ to 3381.63 R$/ha-¹, an increase of 1361.92 R$/ha-¹. An increase of 38.45%. In relation to bioagricultural (C), the difference was smaller, only 4.02 R$/ha-¹, closing at 3377.61 R$/ha-¹. The small difference equals chemical management to bioagricultural, due to different positions in the application of chemical insecticides and fungicides, in which there would be no need, since compared to biological management (A), it produced statistically the same quantity and quality of beans, with a higher positive profitability of the bean crop, as seen in Graph 1, the relationships between total gross income with production costs and profitability. The cost data represent 54.27%, 87.54% and 84.75% of the market cost, respectively, for management systems (A), (B) and (C). A high production cost, such as that of the bean crop, and potential losses, such as those caused by excessive rainfall, determine the success of this crop, since it only had profitability in the biological management system (A) of more than 15% on average, with the other losses exceeding 10%. According to the doses of rock dust, a linear increase in production was obtained, which paid the bill and resulted in a positive profit.

The doses of basalt dust, according to the yield obtained in the different treatments, varied according to the increase in the cost per ton of basalt dust, showing that in biological management (A), the dose of 5 tons/ha-¹ presents the best economic factor of profitability, determined in this case by 25.07 bags/ha-¹ and cost of R$2,229.82/ha-¹. In management (B) the best performance is using 1 ton/ha-¹ of basalt powder, obtaining a better yield of 24.49 bags/ha-¹ and costing R$3,426.09/ha-¹. Bioagricultural management (C) the doses of 3 and 5 ton/ha-¹ present a very small difference due to the high cost of the venal bag, being the best doses to be positioned when management is combined between chemical and biological.Table 4 shows the analysis of variable costs and production costs for wheat crops for the three treatments and their respective categories of direct costs for crop formation and production. It presents values in R$/ha-¹ and R$.sc.venal-1, the value at which the bag of wheat was sold at that time. Regarding the costs of basalt powder, these are presented in detail in yields sc/ha-¹ in the same database R$/ha-¹ and R$.sc.venal-1, per dose of basalt powder.

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In terms of wheat production costs, fertilizers and pesticides stand out, which have shown significant increases of 98% and 200%, respectively, over the last ten years. This is mainly due to the increased use of these inputs in wheat crops, and their acquisition was directly affected by the continued rise in the dollar, thus increasing the total cost of crop production. Due to the increase in the prices of agricultural inputs and their use, there was an upward trend for all costs, with the exception of a slight drop in the last quarter of 2020 (due to a sharp reduction in fixed costs).

TABLE 4: Analysis of production costs between management & basalt powder doses & yields (sc/ha) on variable cost items – 2022 wheat harvest

	ÁREA 01 (A)		ÁREA 02 (B)		ÁREA 03 (C)	
	Trigo Safra 2022					
CUSTOS VARIÁVEIS (CV) - CUSTEIO DE PRODUÇÃO	R$ p/ ha	R$ p/ saca Venal	R$ p/ ha	R$ p/ saca Venal	R$ p/ ha	R$ p/ saca Venal
		R$ 97,20		R$ 97,20		R$ 97,20
Calagem Calcitíco + Gesso (Todas áreas) Fosfato Natural + Úlexita (área 01 e área 03)	R$ 198,23	R$ 4,69	R$ 110,00	R$ 2,22	R$ 198,23	R$ 3,84
MIX de Cobertura - (Inverno 2021) - Custo de Rateio 2 anos (4 cultivos)	R$ 45,00	R$ 1,06	R$ 45,00	R$ 0,91	R$ 45,00	R$ 0,87
Sementes + Trat. Semente	R$ 591,00	R$ 13,97	R$ 591,00	R$ 11,90	R$ 591,00	R$ 11,45
Sulco do plantio (solubilizadores e fixadores de nutrientes)	R$ 105,88	R$ 2,50	n/a	n/a	R$ 105,88	R$ 2,05
Adubos Químicos N-P-K + (Micronutrientes) Úreia (Nitrogênio)	n/a R$ 893,86	n/a R$ 21,13	R$ 1.084,00 R$ 805,56	R$ 21,83 R$ 16,22	R$ 1.084,00 R$ 805,56	R$ 21,01 R$ 15,61
Herbicida pré-emergentes Herbicida pós-emergentes Herbicida final de ciclo – Dessecante	R$ 286,35 R$ 130,80	R$ 6,77 R$ 3,09	R$ 286,35 R$ 130,80	R$ 5,77 R$ 2,63	R$ 286,35 R$ 130,80	R$ 5,55 R$ 2,53
Inseticidas Químicos Bioinseticidas	n/a R$ 150,60	n/a R$ 3,56	R$ 134,00 n/a	R$ 2,70 n/a	R$ 63,80 R$ 132,70	R$ 1,24 R$ 3,25
Fungicidas Químicos Biofungicidas	n/a R$ 189,94	n/a R$ 4,49	R$ 546,35 n/a	R$ 11,00 n/a	R$ 546,35 R$ 144,54	R$ 10,59 R$ 2,80
Nutrição Foliar Química Indução de resistência - Nutrição Biológica - Remineralizadores	n/a R$ 144,78	n/a R$ 3,42	R$ 108,00 n/a	R$ 2,17 n/a	n/a R$ 144,78	n/a R$ 2,81
C. S. R. (2,3%) Funrural	R$ 94,57	R$ 2,24	R$ 111,02	R$ 2,24	R$ 115,36	R$ 2,24
Subtotal - CUSTEIO DE PRODUÇÃO	**R$ 2.830,99**	**R$ 66,92**	**R$ 3.952,08**	**R$ 79,59**	**R$ 4.394,35**	**R$ 85,84**
Rendimento Médio sc/há	***42,30b***		***49,66a***		***51,60a***	
Var. % Custeio Sobre Valor Venal		**68,85%**		**81,88%**		**88,31%**

Doses Pó de Basalto	Rento sc/há	R$ p/ ha	R$ p/ saca Venal	Rento sc/há	R$ p/ ha	R$ p/ saca Venal	Rento sc/há	R$ p/ ha	R$ p/ saca Venal
0	*34,61bC*	R$ 2.813,80	R$ 81,30	*41,68abB*	R$ 3.934,24	R$ 94,39	*44,17aB*	R$ 4.377,72	R$ 99,11
1	*37,64bBC*	R$ 2.860,58	R$ 76,00	*47,24aAB*	R$ 3.986,67	R$ 84,39	*48,70aAB*	R$ 4.427,85	R$ 90,92
3	*46,27bAB*	R$ 2.959,80	R$ 64,01	*53,24abA*	R$ 4.080,08	R$ 76,64	*57,10aA*	R$ 4.526,63	R$ 79,28
5	*48,20bA*	R$ 3.044,18	R$ 63,16	*55,57abA*	R$ 4.165,29	R$ 74,96	*56,19aA*	R$ 4.604,59	R$ 81,95
7	*45,34cAB*	R$ 3.117,79	R$ 68,76	*51,7abA*	R$ 4.236,64	R$ 81,95	*55,29aA*	R$ 4.682,58	R$ 84,69
9	*41,76aABC*	R$ 3.189,79	R$ 76,38	*48,52aAB*	R$ 4.309,53	R$ 88,82	*48,15aAB*	R$ 4.746,62	R$ 98,58

Source: prepared by the authors, 2023.

In the same analysis, the costs of fertilizers in the sum of NPK + urea (N) are R$1,889.56/ha-¹ in management (B) and (C), totaling 47.81% and 42.99% of the total cost, respectively, and 37.05% and 34.35% of the total cost, respectively. Results equivalent to those presented in chemical and conventional management, with this cost being very high in fact. It is worth remembering that the doses of fertilizer and urea used were low (200 kg/ha-¹ and 137 kg/ha-¹) respectively, compared to the volumes normally used in wheat cultivation, and even so, due to the increase in costs, we have this negative potential in production costs. In biological management (A), the cost of urea alone represented only 31.57%, due to the low cost value presented in this treatment. In wheat cultivation, the main production costs are related to inputs such as fertilizers, pesticides and seeds, in addition to agricultural operations. Fertilizer prices have increased by more than 100% in the last year. According to estimates, in the 2022 harvest, wheat crops will cost around R$4,223.27/ha-¹.

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Fertilizers represent 27.25% of variable costs, followed by machine operations (10%), pesticides (8.48%) and seeds (7.37%). To balance costs, productivity needs to reach 48 bags per hectare, but the average has been 42 bags. The upward trend in costs is expected to continue due to exchange rate appreciation, low stocks and problems in producing regions. Management and cost control practices are important, seeking a balance between yield and profitability. Pesticides are the third most important item, right behind fertilizers and machine operations. The highest cost is with fungicides, especially in years with adverse weather, where humidity favors the incidence of fungal diseases.

In practice, the total costs of wheat crops were higher, costing over R$5,000.00/ton-1 in management (B) and (C), and in the range of R$4,800.00/ha-¹ in biological management (A). We can see that the total costs are equivalent to each other in relation to the different treatments, therefore, production costs are the highlight for the success of wheat farming in the southern region of Brazil. With a cost of R$2,830.99/ha-¹ for management (A) versus R$3,952.08/ha-¹ for area management (B), the difference being R$1,121.09/ha-¹ (28.36%). The bioagricultural treatment of wheat has not been shown to be economically positive, as it has a higher cost and total cost than chemical management (B). This is due to the association of inoculants while maintaining the same fertilizer dose in the furrow, which needs to be reduced to make this positioning efficient, plus the increase in one application of chemical insecticide that cost R$63.80/ha-¹ and one application of biofungicide that cost an additional R$144.54/ha-¹.

In biological management (A), the production factor, yield sc/ha-¹, was much lower than expected, with no positive responses in the nutritional positioning of this treatment in the wheat crop. In other words, the lack of mineral elements in the planting furrow (NPK + micro) was lacking in the growth and economic responses of the crop. Therefore, the difference between 42.30 bags/ha-¹ (A) and 49.66 bags/ha-¹ (B) was 7.36 bags/ha-¹, corresponding to R$ 715.39 in the value of a bag of R$ 97.20. Considering that the difference in cost between the current managements was R$ 1,121.09/ha-¹, we have a small difference between bags and cost of R$ 714.27/ha-¹, a value that raises questions about the action of using only basalt powder as a primary source in wheat crops. Obviously, we must take into account that the climatic factors were negative in the responses that we could have obtained, for which new evaluations should be carried out.

Regarding the different doses of basalt powder about yields sc/ha-¹ versus cost, it shows that in management (A) the dose of 5 ton/ha-¹ with 48.20 sc/ha-¹, the best result

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compared to the other doses and in equivalence to the cost. In management (B) it is also 5 ton/ha-¹ and the result is 55.57 sc/ha-¹, much higher than the biological management at the same dose. The cost of 4,165.29 R$/ha-¹ is the best in response to the dose of basalt powder. On the other hand, bioagricultural management (C) due to its cost already high demonstrated that 3 ton/ha-¹ were very expressive in the response of yield and cost. By observing Graph 1, it is possible to see the high loss that chemical and agricultural treatments presented in this crop in 2022. In Table 5, the profitability percentage was expressed positively at doses of 3 and 5 tons/ha-¹ in the management area (A), being 5.32% and 6.52% respectively. However, in managements (B) and (C) expressed in Tables 74 and 75 respectively, the profitability losses were -5.78% and -3.77% (B), -8.74%, and -11.61% (C). Considering this level of economic analysis despite the losses in yield, biological management obtained a higher profitability result compared to the other managements analyzed. Table 5 shows the analysis of variable costs and production costs in soybean crops for the three treatments and their respective categories of direct costs in crop formation and production. It presents values in R$/ha-¹ and R$.sc.venal-1, the value at which the bag of soybeans was sold at that time. Regarding the costs of basalt powder, the same is presented in detail in yields sc/ha-¹ in the same database R$/ha-¹ and R$.sc.venal, per dose of basalt powder. Table 5 presents the costs of applying insecticides and fungicides to the 2022/2023 soybean crop for three different treatments (A, B, and C), using the COMPACTA cultivar. Each treatment involves the use of different products to control insects and diseases that can affect the development of the crop. The treatments use insecticides and fungicides, both chemical and biological, to combat pests and diseases that affect soybeans. In addition, the treatments also use adjuvant products and vegetable oil to improve the effectiveness of the applications. The costs vary for each treatment and include the expenses of the products used and the cost of the applications.

Among the general inputs, herbicides stand out with a greater impact, corresponding to 33.82%, followed by fertilizers with 29.73%. The costs with fertilizers in the soybean crop presented in Table 5 represent the production cost, zero in biological management (A), in chemical management (B) represents 17.98% and 23.09% of agricultural management. The cost values were 2169.67 R$/ha-¹ (A), 4429.83 R$/ha-¹ (B), and 3448.14 R$/ha-¹ (C), that is, agricultural management was less than chemical management and this increased the percentage of fertilizer representation compared to lower cost. The cost of fertilizers was

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not high compared to crop averages; this decision was made lower because the year was marked by La Niña climate effects, which automatically increases the risks.

TABLE 5: Analysis of production costs between management methods & basalt powder doses & yields (sc/ha) on variable cost items – 2022/2023 harvest

	ÁREA 01 (A)		ÁREA 02 (B)		ÁREA 03 (C)	
	Soja Safra 2022.2023					
CUSTOS VARIÁVEIS (CV) - CUSTEIO DE PRODUÇÃO	R$ p/ ha	R$ p/ saca Venal	R$ p/ ha	R$ p/ saca Venal	R$ p/ ha	R$ p/ saca Venal
		R$ 140,00		R$ 140,00		R$ 140,00
Calagem Calcitíco + Gesso (Todas áreas) Fosfato Natural + Úlexita (área 01 e área 03)	R$ 198,23	R$ 2,48	R$ 110,00	R$ 1,60	R$ 198,23	R$ 2,65
MIX de Cobertura - (Inverno 2021) - Custo de Rateio 2 anos (4 cultivos)	R$ 45,00	R$ 0,56	R$ 45,00	R$ 0,65	R$ 45,00	R$ 0,60
Sementes + Trat. Semente	R$ 713,00	R$ 8,92	R$ 713,00	R$ 10,36	R$ 713,00	R$ 10,25
Sulco do plantio (solubilizadores e fixadores de nutrientes)	R$ 41,00	R$ 0,51	n/a	n/a	R$ 41,00	R$ 0,55
Adubos Químicos N-P-K + (Micronutrientes)	n/a	n/a	R$ 796,50	R$ 11,58	R$ 796,50	R$ 11,45
Úreia (Nitrogênio)	n/a	n/a	n/a	n/a		
Herbicida pré-emergentes	R$ 218,61	R$ 2,73	R$ 218,61	R$ 3,18	R$ 218,61	R$ 2,93
Herbicida pós-emergentes	R$ 129,35	R$ 1,62	R$ 129,35	R$ 1,88	R$ 129,35	R$ 1,73
Herbicida final de ciclo – Dessecante	n/a	n/a	n/a	n/a		
Inseticidas Químicos	n/a	n/a	R$ 361,59	R$ 5,25	R$ 44,65	R$ 0,60
Bioinseticidas	R$ 233,66	R$ 2,92	n/a	n/a	R$ 175,62	R$ 2,35
Fungicidas Químicos	n/a	n/a	R$ 1.777,31	R$ 25,83	R$ 580,71	R$ 7,78
Biofungicidas	R$ 198,23	R$ 2,48	n/a	n/a	R$ 161,94	R$ 2,17
Nutrição Foliar Química	n/a	n/a	R$ 56,90	R$ 0,83	n/a	n/a
Indução de resistência - Nutrição Biológica - Remineralizadores	R$ 135,18	R$ 1,69	n/a	n/a	R$ 103,09	R$ 1,38
C. S. R. (2,3%) Funrural	R$ 257,41	R$ 3,22	R$ 221,57	R$ 3,22	R$ 240,44	R$ 3,22
Subtotal - CUSTEIO DE PRODUÇÃO	**R$ 2.169,67**	**R$ 27,13**	**R$ 4.429,83**	**R$ 64,38**	**R$ 3.448,14**	**R$ 47,67**
Rendimento Médio sc/há	*79,94a*		*68,84b*		*74,67ab*	
Var. % Custeio Sobre Valor Venal		**19,38%**		**45,99%**		**34,05%**

Doses Pó de Basalto	Rento sc/há	R$ p/ ha	R$ p/ saca Venal	Rento sc/há	R$ p/ ha	R$ p/ saca Venal	Rento sc/há	R$ p/ ha	R$ p/ saca Venal
0	*79,23aA*	R$ 2.131,41	R$ 31,32	*68,06aA*	R$ 4.463,38	R$ 56,33	*71,39aA*	R$ 3.437,57	R$ 48,15
1	*75,27aA*	R$ 2.178,07	R$ 31,06	*70,13aA*	R$ 4.490,63	R$ 59,66	*70,61aA*	R$ 3.475,06	R$ 49,21
3	*75,47aA*	R$ 2.254,08	R$ 32,72	*68,89aA*	R$ 4.571,28	R$ 60,57	*84,03aA*	R$ 3.598,27	R$ 42,82
5	*84,50aA*	R$ 2.338,65	R$ 33,26	*70,31aA*	R$ 4.678,90	R$ 55,67	*74,72aA*	R$ 3.648,29	R$ 48,83
7	*86,57aA*	R$ 2.399,27	R$ 37,32	*64,29bA*	R$ 4.695,28	R$ 73,03	*73,91abA*	R$ 3.725,68	R$ 50,41
9	*78,62aA*	R$ 2.501,39	R$ 35,15	*71,16aA*	R$ 4.797,40	R$ 67,42	*73,40aA*	R$ 3.804,04	R$ 51,83

Source: prepared by the authors, 2023.

Regarding herbicide costs, the doses and products applied equally between pre- and post-emergence treatments were R$347.96/ha-¹, equivalent to 2.48 bags of soybeans. Representing 7.85% in chemical management about the cost of treatments in the chemical management area (B).

Regarding entomological and phytopathological controls, their costs are presented between treatments. Management (A) was R$233.66/ha-¹ against R$361.59/ha-¹ in management (B), a difference of 35.37%. In agricultural management (C), the costs were only R$44.65/ha-¹ (chemical insecticides) plus R$175.62/ha-¹ (bioinsecticides), totaling R$220.27/ha-¹, establishing a lower value than biological management itself, due to the excellent positioning of a chemical application and insecticide in the soybean crop.

Regarding entomological and phytopathological controls, their costs are presented between treatments. Management (A) was R$233.66/ha-¹ versus R$361.59/ha-¹ in management (B), a difference of 35.37%. In agricultural management (C), the costs were only R$44.65/ha-¹ (chemical insecticides) plus R$175.62/ha-¹ (bioinsecticides), totaling R$220.27/ha-¹, establishing a lower value than biological management itself, due to the excellent positioning of a chemical application and insecticide in the soybean crop.

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Regarding fungicides, the differences were quite significant between the management methods. Starting from R$198.23/ha-¹ of biological management (A) throughout the soybean crop, compared to R$1,777.31/ha-¹ in chemical management (B), a difference of R$1,579.08/ha-¹, a difference of 88.84%. This value comprises four applications of chemical fungicides, mainly for Sclerotinia s. and Pakopsora p. In the case of agricultural management, the sum of biofungicides and chemical fungicides totaled R$742.65/ha-¹, with only one application of chemical fungicide for R$580.71/ha-¹; the other three (3) applications were with bio fungicides.

Among management areas (A) and management (C), the fungicide Trichoderma h. was positioned in 2 and 1 application respectively between management, as well as B. subtillis in both areas, there were 3 applications, all aimed at controlling Sclerotinia sclerotiorum. It is important to highlight the cost based on yield losses sc/ha-¹, as shown in Table 67. Losses due to this disease were extremely low in management (A) and considerable loss in management (C), with the difference being only shown by the positioning of the fungicide in the initial phases. When observing chemical management (B), the losses are extremely significant and have high economic impacts, and the chemical fungicides used were not efficient, in addition to the high cost.

The total cost of the biological area (A) compared to the total cost of production was 48.21% on average. In chemical management (B) it corresponded to more than 63%, compared to the average representation of 58.44% in management (C). Values that make up a fundamental decision factor when leveling the economic factors of production based on costs. However, it is possible to analyze the cost between managements compared to the sales value of soybeans, which at a value of R$ 140.sc-1 represented 19.38% (A), 45.99% (B) and 34.05% (C), once again exposing the low-cost value in soybean production in both 100% biological and agricultural management. Therefore, if soybeans were sold at a price 15 R$/ha-¹ lower, we would be squeezing the profitability margins of the crop.

Regarding the different doses of basalt powder about yields sc/ha-¹ versus cost, it shows that in management (A) the dose of 5 and 7 tons/ha-¹ with 84.50 and 86.57 sc/ha-¹, better results compared to the other doses and in equivalence to cost. In management (B) it is 1 ton/ha-¹ with a result of 70.13 tons/ha-¹, values even equivalent to the dose of 5 tons/ha-¹, however, the losses due to disease greatly affected this result. On the other hand, the bioagricultural management (C) due to its cost and yield demonstrated that 3 tons/ha-¹

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were very expressive in the comparative analysis. In the interaction between economic factors of soybeans combined with technical factors and doses of basalt powder in chemical/conventional areas, only 1 ton/ha-¹ was it possible to see statistical differences, whereas in 100% biological (A) and agricultural (C) management, doses of 5/7 and 3 ton/ha-¹ respectively combined with interactions of the soil biocenosis expressed much higher results in yields combined with a considerable reduction in costs and total production costs.

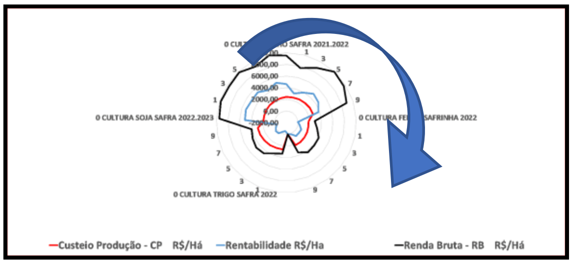
ECONOMIC ANALYSIS OF INDICATORS IN ANNUAL CROPS

Management as a decision-making process seeks to evaluate the allocation of available resources so that they can be applied in environments with a lack of certainty and high risk involved in the production sector since it is the path to obtaining value in sustainable management (LOURENZANI, et. al., 2017).

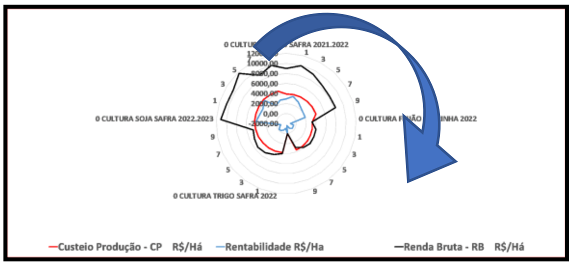
In Graph 1, the relationship between gross income minus production costs and the resulting profitability sc/ha-¹ shows the respective results of the 4 crop cycles in two years of cultivation:

Graph 1: Economic analysis between gross income, production costs, and profitability in different basalt powder industries – Referring to areas (A), (B), and (C)

(A)



(B)



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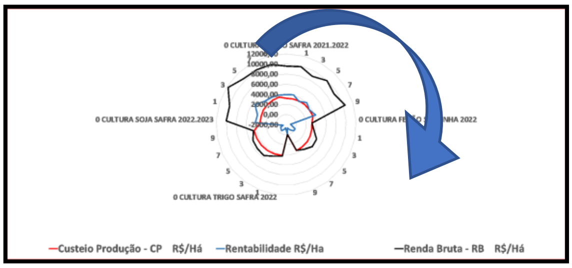
(C)



Source: prepared by the authors, 2023.

It is possible to observe that the highest revenues of the company “Lavoura Propriedade Agricultura” are linked to the total grains produced per area and the value at which they are sold on the market. However, in Graph 1, the crops with the highest revenues were corn and soybeans, even though corn had reduced production due to water stress, offset by the high market value of R$88.00/ha-¹. The bean crop has a high added value, however, its production is below 25 bags/ha-¹, and the low market value did not promote high revenues in the period. In the wheat crop, the market value was very good compared to previous years, however the low yield did not favor full revenue.

The related production cost values are presented as a constant in the management area (B), always close to or above R$4,000.00/ha-¹ in all crops operated. In agricultural management, the area used for soybean cultivation is smaller compared to management (B); however, in biological management (A), all values are lower when compared between crops and different management methods. From an economic point of view, the adoption of green manures can bring significant savings. With the continued use of this technology, production costs are reduced, since there is less dependence on external inputs. The return on investment measured by the Internal Rate of Return (IRR), which represents the discount rate that equals the sum of cash flows to the value of the investment, was high, reaching 6.05%. The Benefit/Cost ratio was obtained by dividing the revenues and the current value of the costs was also positive. Thus, the analysis shows that the technology obtained an index of 2.16, indicating that the technology is efficient. These results indicate that the amount of money that the producer will have available at the end of the project is much higher than the investment made. Table 6 presents the analysis of the economic indicators of area (A).

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TABLE 6: Analysis of economic indicators of the area (A)

	ÁREA 01 (A)											
	DOSES PÓ DE BASALTO - Ton./há						DOSES PÓ DE BASALTO - Ton./há					
	0	1	3	5	7	9	0	1	3	5	7	9
	CULTURA MILHO SAFRA 2021.2022						CULTURA FEIJÃO SAFRINHA 2022					
RENDIMENTO sc/há	108,07AB	86,90 B	99,23 AB	113,53 A	110,17 A	100,87AB	17,44A	20,30A	24,85A	25,07A	25,84A	21,05A
Análise de custos - Dose pó de basalto & R$ p/ ha & Culturas Anuais												
Renda Bruta - RB R$/Há	9510,16	7647,20	8732,24	9990,64	9694,96	8876,56	2895,18	3369,96	4125,30	4161,82	4289,65	3494,47
Custos Variáveis – CV R$/há	4359,51	3984,07	4306,03	4666,66	4680,72	4578,22	2381,50	2527,38	2775,82	2863,96	2972,47	2875,14
(%) R$/há	45,84	52,10	49,31	46,71	48,28	51,58	82,26	75,00	67,29	68,82	69,29	82,28
Custeio Produção - CP R$/Há	2457,48	2454,63	2559,59	2668,53	2741,73	2802,90	1802,47	1853,39	1950,76	2031,60	2114,54	2176,25
Custeio Variável Serviços RS/Ha	1902,03	1529,44	1746,45	1998,13	1938,99	1775,31	579,04	673,99	825,06	832,36	857,93	698,89
Margem de Contribuição – MC R$/Há	5150,65	3663,13	4426,21	5323,98	5014,24	4298,34	513,68	842,58	1349,48	1297,86	1317,18	619,33
Custos Fixos – CF R$/Há	517,11	517,11	517,11	517,11	517,11	517,11	517,11	517,11	517,11	517,11	517,11	517,11
(%) R$/há	5,44%	6,76%	5,92%	5,18%	5,33%	5,83%	17,86%	15,34%	12,54%	12,43%	12,05%	14,80%
Rentabilidade R$/Ha	4633,54	3146,02	3909,10	4806,87	4497,13	3781,23	-3,43	325,48	832,37	780,75	800,07	102,22
(%) R$/há	48,72	41,14	44,77	48,11	46,39	42,60	-0,12	9,66	20,18	18,76	18,65	2,93
Renda da Operação Agricola – ROA R$/Ha	4633,54	3146,02	3909,10	4806,87	4497,13	3781,23	-3,43	325,48	832,37	780,75	800,07	102,22
Custo Total – CT R$/Há	4876,62	4501,18	4823,14	5183,77	5197,83	5095,33	2898,61	3044,49	3292,93	3381,07	3489,58	3392,25
(%) R$/há	51,28	58,86	55,23	51,89	53,61	57,40	100,12	90,34	79,82	81,24	81,35	97,07
Ponto de Equilibrio – PE R$/Há	954,79	1079,52	1020,18	970,37	999,82	1067,89	2914,52	2068,21	1580,78	1658,21	1684,06	2917,73

	ÁREA 01 (A)											
	DOSES PÓ DE BASALTO - Ton./há						DOSES PÓ DE BASALTO - Ton./há					
	0	1	3	5	7	9	0	1	3	5	7	9
	CULTURA TRIGO SAFRA 2022						CULTURA SOJA SAFRA 2022.2023					
RENDIMENTO sc/há	34,61C	37,64BC	46,27AB	48,20A	45,34AB	41,76ABC	79,23A	75,27A	75,47A	84,05A	64,29A	71,16A
Análise de custos - Dose pó de basalto & R$ p/ hectare & Culturas Anuais												
Renda Bruta - RB R$/Há	3364,09	3658,61	4497,44	4685,04	4407,05	4059,07	9528,40	9818,20	9644,60	9843,40	9000,60	9962,40
Custos Variáveis – CV R$/há	3288,40	3394,07	3661,13	3782,97	3800,97	3803,38	3838,86	3943,49	3984,77	4109,11	4001,16	4295,54
(%) R$/há	97,75	92,77	81,40	80,75	86,25	93,70	40,29	40,17	41,32	41,74	44,45	43,12
Custeio Produção - CP R$/Há	2615,58	2662,35	2761,64	2845,96	2919,56	2991,56	1933,18	1979,85	2055,85	2140,43	2201,04	2303,16
Custeio Variável Serviços RS/Ha	672,82	731,72	899,49	937,01	881,41	811,81	1905,68	1963,64	1928,92	1968,68	1800,12	1992,48
Margem de Contribuição – MC R$/Há	75,70	264,54	836,31	902,07	606,07	255,70	5689,54	5874,71	5659,83	5734,29	4999,44	5666,76
Custos Fixos – CF R$/Há	596,83	596,83	596,83	596,83	596,83	596,83	596,83	596,83	596,83	596,83	596,83	596,83
(%) R$/há	17,74%	16,31%	13,27%	12,74%	13,54%	14,70%	6,26%	6,08%	6,19%	6,06%	6,63%	5,99%
Rentabilidade R$/Ha	-521,13	-332,29	239,48	305,24	9,24	-341,13	5092,71	5277,88	5063,00	5137,46	4402,61	5069,93
(%) R$/há	-15,49	-9,08	5,32	6,52	0,21	-8,40	53,45	53,76	52,50	52,19	48,91	50,89
Renda da Operação Agricola – ROA R$/Ha	-521,13	-332,29	239,48	305,24	9,24	-341,13	5092,71	5277,88	5063,00	5137,46	4402,61	5069,93
Custo Total – CT R$/Há	3885,22	3990,90	4257,96	4379,80	4397,80	4400,21	4435,69	4540,32	4581,60	4705,94	4597,99	4892,47
(%) R$/há	115,49	109,08	94,68	93,48	99,79	108,40	46,55	46,24	47,50	47,81	51,09	49,11
Ponto de Equilibrio – PE R$/Há	26524,07	8254,33	3209,58	3099,72	4339,83	9474,42	999,52	997,46	1017,03	1024,51	1074,49	1049,25

Source: prepared by the authors, 2023.

The indexes indicated a total cost of implementing the project of R$3,133,188.59, while revenue reached R$5,025,773.97, resulting in a net profit of R$1,892,585.38. The payback was achieved in six months, and the IBC ratio was 1.60. Concluding that the implementation of the project is economically viable, representing an investment option that avoids monoculture and contributes to the diversification of production. Thus, with greater increases in revenue and reduction of production costs with the integration of technical and administrative systems and crops.

One of the reasons why the contribution margins between the two treatments evaluated were the same is the increase in the variable cost of outsourced production, categorized as direct services, during the harvest and transportation of soybeans (BELLÉ, 2021). This variable had little influence on the variable costs of the service in this study; what we see is a percentage increase in the case of yield results with low gross income between the different doses of basalt powder.

Regarding fixed costs, they represent the values of limestone and gypsum in a factor of apportionment in 4 crops, or 2 years to dilute the proportional value. Another value is the labor of the biofactory operated by an operator who receives a fixed salary plus housing to carry out the multiplication of microorganisms. It is possible to observe that fixed costs vary between 500 and 700.00 R$/ha-¹ in areas (A) and area (C) higher compared to area (B) chemical between 400 and 470.00 R$/ha-¹. This is due to the use of Ulexite and natural phosphate in areas (A) and (C) of sustainable management, unlike area (B) which maintains traditional management with a reduction in fixed costs, but with an increase in production costs.

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Table 7 shows the management and administrative indicators of the 100% biological area (B) on the different doses of basalt powder.

TABLE 7: Analysis of the area's economic indicators (B)

	ÁREA 02 (B)											
	DOSES PÓ DE BASALTO - Ton./há						DOSES PÓ DE BASALTO - Ton./há					
	0	1	3	5	7	9	0	1	3	5	7	9
	CULTURA MILHO SAFRA 2021.2022						CULTURA FEIJÃO SAFRINHA 2022					
RENDIMENTO sc/há	102,37A	112,90A	104,57A	96,13A	93,77A	94,97A	19,05A	24,49A	24,77A	25,53A	23,53A	18,56A
Análise de custos - Dose pó de basalto & R$ p/ ha & Culturas Anuais												
Renda Bruta - RB R$/Há	9008,56	9935,20	9202,16	8459,44	8251,76	8357,36	3162,45	4065,54	4112,02	4238,18	3906,17	3081,11
Custos Variáveis – CV R$/há	5712,20	5958,84	5875,37	5789,75	5823,43	5926,98	3887,81	4129,20	4219,57	4327,70	4333,66	4229,57
(%) R$/há	63,41	59,98	63,85	68,44	70,57	70,92	122,94	101,57	102,62	102,11	110,94	137,28
Custeio Produção - CP R$/Há	3910,49	3971,80	4034,94	4097,86	4173,08	4255,51	3255,32	3316,09	3397,16	3480,07	3552,43	3613,45
Custeio Variável Serviços R$/Ha	1801,71	1987,04	1840,43	1691,89	1650,35	1671,47	632,49	813,11	822,40	847,64	781,23	616,22
Margem de Contribuição – MC R$/Há	3296,35	3976,36	3326,79	2669,69	2428,33	2430,38	-725,36	-63,67	-107,55	-89,52	-427,49	-1148,57
Custos Fixos – CF R$/Há	397,38	397,38	397,38	397,38	397,38	397,38	397,38	397,38	397,38	397,38	397,38	397,38
(%) R$/há	4,41	4,00	4,32	4,70	4,82	4,75	12,57	9,77	9,66	9,38	10,17	12,90
Rentabilidade R$/Ha	2898,98	3578,98	2929,41	2272,31	2030,94	2033,00	-1122,74	-461,05	-504,93	-486,90	-824,88	-1545,95
(%) R$/há	32,18	36,02	31,83	26,86	24,61	24,33	-35,50%	-11,34%	-12,28%	-11,49%	-21,12%	-50,18%
Renda da Operação Agrícola – ROA R$/Ha	2898,98	3578,98	2929,41	2272,31	2030,94	2033,00	-1122,74	-461,05	-504,93	-486,90	-824,88	-1545,95
Custo Total – CT R$/Há	6109,58	6356,22	6272,75	6187,13	6220,82	6324,36	4285,20	4526,58	4616,95	4725,08	4731,05	4627,06
(%) R$/há	67,82	63,98	68,17	73,14	75,39	75,67	135,50	111,34	112,28	111,49	121,12	150,18
Ponto de Equilibrio – PE R$/Há	1086,00	992,89	1099,19	1259,18	1350,35	1366,48	-1732,52	-25375,70	-15193,42	-18813,78	-3631,02	-1066,01

	DOSES PÓ DE BASALTO - Ton./há						DOSES PÓ DE BASALTO - Ton./há					
	0	1	3	5	7	9	0	1	3	5	7	9
	CULTURA TRIGO SAFRA 2022						CULTURA SOJA SAFRA 2022.2023					
RENDIMENTO sc/há	41,68B	47,24AB	53,24A	55,57A	51,7A	48,52AB	68,06A	70,13A	68,89A	70,31A	64,29A	71,16A
Análise de custos - Dose pó de basalto & R$ p/ hectare & Culturas Anuais												
Renda Bruta - RB R$/Há	4051,30	4591,73	5174,93	5401,40	5025,24	4716,14	11092,19	10537,80	10565,80	11757,00	9000,60	9962,40
Custos Variáveis – CV R$/há	4634,50	4795,02	5005,07	5135,57	5131,69	5142,76	6571,82	6488,19	6574,44	6922,30	6385,40	6679,88
(%) R$/há	114,40	104,43	96,72	95,08	102,12	109,05	59,25	61,57	62,22	58,83	70,94	67,05
Custeio Produção - CP R$/Há	3824,24	3876,67	3970,08	4055,29	4126,64	4199,53	4353,38	4380,63	4461,28	4568,90	4585,28	4687,40
Custeio Variável Serviços R$/Ha	810,26	918,35	1034,99	1080,28	1005,05	943,23	2218,44	2107,56	2113,16	2353,40	1800,12	1992,48
Margem de Contribuição – MC R$/Há	-583,20	-203,29	169,86	265,83	-106,45	-426,62	4520,37	4049,61	3991,36	4844,70	2615,20	3282,52
Custos Fixos – CF R$/Há	469,23	469,23	469,23	469,23	469,23	469,23	469,23	469,23	469,23	469,23	469,23	469,23
(%) R$/há	11,58	10,22	9,07	8,69	9,34	9,95	4,23	4,45	4,44	3,99	5,21	4,71
Rentabilidade R$/Ha	-1052,43	-672,52	-299,37	-203,40	-575,68	-895,84	4051,14	3580,38	3522,14	4375,47	2145,98	2813,29
(%) R$/há	-25,98%	-14,65%	-5,78%	-3,77%	-11,46%	-19,00%	36,52%	33,98%	33,34%	37,18%	23,84%	28,24%
Renda da Operação Agrícola – ROA R$/Ha	-1052,43	-672,52	-299,37	-203,40	-575,68	-895,84	4051,14	3580,38	3522,14	4375,47	2145,98	2813,29
Custo Total – CT R$/Há	5103,73	5264,24	5474,30	5604,80	5600,92	5611,99	7041,05	6957,42	7043,66	7391,53	6854,62	7149,11
(%) R$/há	125,98	114,65	105,78	103,77	111,46	119,00	63,48	66,02	66,66	62,82	76,16	71,76
Ponto de Equilibrio – PE R$/Há	-3259,55	-10598,62	14295,50	9534,21	-22151,38	-5187,20	1151,40	1221,01	1242,12	1139,68	1614,92	1424,10

Source: prepared by the authors, 2023.

The total cost of production is the sum of the variable cost values plus the fixed costs in the formation of the economic operation of the crops. The lowest total cost of production was for beans, followed by wheat and corn, and the highest values were for soybean crops in the treatment area (B). The biological area (A) shows the total costs for beans followed by wheat, but the costs for corn were higher than for soybean crops, and the opposite is true for management (B). This is largely due to the reduction in cost values, which are quite economically representative in management (A).

On the other hand, the total costs of bean and wheat crops were high, with a significant reduction in corn and especially in soybean crops in agricultural management (C). Their representativeness is attributed to the considerable reduction in production costs. The contribution margins in the soybean harvest in the biological area were above 53% of the total revenue (gross income), much higher than the chemical area (B) in the range of 33 to 36% and in the agricultural area (C) in the estimated 43 to 46%. The bean area (A) at 1349.48 R$/ha^{-1} at the dose of 3 R$/ha^{-1}, presents the highest contribution margin, unlike area (B) which showed a negative contribution margin, that is, losses in the bean production under all conventional cultural treatments, impacted by the loss of potential yield sc/ha^{-1}. The 3 and 5 R$/ha^{-1} of basalt powder in treatment (C) presented a positive contribution margin mainly due to the high yield produced at these doses. In the wheat crop, chemical management (B) stands out with totally negative results in MC, unsatisfactory yields with high production costs. Unlike management (A), which presented a

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more controlled cost and at doses of 4 and 5 R$/ha-¹, it presented a positive economic relationship.

The contribution margin between treatments is functional in the subtraction between gross income minus variable costs, therefore in the soybean crop, the contribution margin exceeded closing an average of 58% of the total revenue of the soybean crop in the biological treatment (A), and automatically with profitability above 50%. In bioagricultural management, the results are that the contribution margin is above 45%, but maintaining profitability above 40%. In contrast, in the 100% conventional treatment (B), the contribution margins remain at 36% between the different doses of basalt powder and with profitability on average of 32%. Therefore, the opportunity cost should be routine in cost analyses of agricultural production between crops of economic interest. Table 8 highlights the economic and financial indicators of agricultural treatments (C) among the four annual crops evaluated using different doses of basalt powder.

TABLE 8: Analysis of economic indicators of the area (C)

	DOSES PÓ DE BASALTO - Ton./há						DOSES PÓ DE BASALTO - Ton./há					
	0	1	3	5	7	9	0	1	3	5	7	9
	CULTURA TRIGO SAFRA 2022						CULTURA SOJA SAFRA 2022.2023					
RENDIMENTO sc/há	44,17B	48,70AB	57,10A	56,19A	55,29A	48,15AB	71,39A	70,61A	84,03A	74,72A	73,91A	73,40A
	Análise de custos - Dose pó de basalto & R$ p/ ha & Culturas Anuais											
Renda Bruta - RB R$/Há	4293,32	4733,64	5550,12	5461,67	5374,19	4580,18	9994,60	9885,40	11764,20	10450,80	10347,40	10275,00
Custos Variáveis – CV R$/há	5038,16	5176,35	5438,43	5498,70	5559,19	5484,43	5238,27	5253,91	5752,89	5542,23	5596,94	5661,02
(%) R$/há	117,35	109,35	97,99	100,68	103,44	117,18	52,41	53,15	48,90	52,98	54,09	55,09
Custeio Produção - CP R$/Há	4179,50	4229,62	4328,40	4406,37	4484,36	4548,39	3239,35	3276,83	3400,05	3450,07	3527,46	3605,82
Custeio Variável Serviços RS/Ha	858,66	946,73	1110,02	1092,33	1074,84	936,04	1998,92	1977,08	2352,84	2092,16	2069,48	2055,20
Margem de Contribuição – MC R$/Há	-744,84	-442,71	111,69	-37,03	-185,01	-804,25	4756,33	4631,49	6011,31	4918,57	4750,46	4614,98
Custos Fixos – CF RS/Há	596,83	596,83	596,83	596,83	596,83	596,83	596,83	596,83	596,83	596,83	596,83	596,83
(%) R$/há	13,90%	12,61%	10,75%	10,93%	11,11%	12,75%	5,97%	6,04%	5,07%	5,71%	5,77%	5,81%
Rentabilidade R$/Ha	-1341,67	-1039,54	-485,14	-633,86	-781,84	-1401,08	4159,50	4034,66	5414,48	4321,74	4153,63	4018,15
(%) R$/há	-31,25	-21,96	-8,74	-11,61	-14,55	-29,94	41,62%	40,81%	46,03%	41,31%	40,14%	39,10%
Renda da Operação Agrícola – ROA R$/Ha	-1341,67	-1039,54	-485,14	-633,86	-781,84	-1401,08	4159,50	4034,66	5414,48	4321,74	4153,63	4018,15
Custo Total – CT R$/Há	5634,99	5773,18	6035,26	6095,53	6156,02	6081,26	5835,10	5850,74	6349,72	6139,06	6193,77	6257,85
(%) R$/há	131,25	121,96	108,74	111,61	114,55	129,94	58,38	59,19	53,97	58,59	59,86	60,90
Ponto de Equilibrio – PE R$/Há	-3440,19	-6381,53	29656,92	-88018,84	-17337,15	-3473,14	1254,13	1273,87	1168,00	1259,34	1300,01	1328,94

	ÁREA 03 (C)											
	DOSES PÓ DE BASALTO - Ton./há						DOSES PÓ DE BASALTO - Ton./há					
	0	1	3	5	7	9	0	1	3	5	7	9
	CULTURA MILHO SAFRA 2021.2022						CULTURA FEIJÃO SAFRINHA 2022					
RENDIMENTO sc/há	108,93A	111,27A	100,77A	112,43A	106,27A	117,93A	19,24A	21,99A	28,60A	28,90A	24,51A	20,82A
	Análise de custos - Dose pó de basalto & R$ p/ ha & Culturas Anuais											
Renda Bruta - RB R$/Há	9588,48	9791,76	8867,76	9893,84	9351,76	10377,84	3194,03	3650,56	4747,89	4797,69	4068,91	3456,33
Custos Variáveis – CV R$/há	5125,84	5211,17	5085,12	5393,94	5353,05	5661,87	3799,97	3941,78	4266,48	4357,59	4275,07	4218,47
(%) R$/há	53,46	53,22	57,34	54,52	57,24	54,56	118,97	107,98	89,86	90,83	105,07	122,05
Custeio Produção - CP R$/Há	3208,09	3252,82	3311,57	3415,17	3482,70	3586,30	3161,17	3211,67	3316,91	3398,05	3461,29	3527,20
Custeio Variável Serviços RS/Ha	1917,17	1958,35	1773,55	1978,77	1870,35	2075,57	638,81	730,11	949,58	959,54	813,78	691,27
Margem de Contribuição – MC R$/Há	4462,64	4580,59	3782,64	4499,90	3998,71	4715,97	-605,94	-291,22	481,40	440,10	-206,17	-762,14
Custos Fixos – CF RS/Há	517,11	517,11	517,11	517,11	517,11	517,11	517,11	517,11	517,11	517,11	517,11	517,11
(%) R$/há	5,39	5,28	5,83	5,23	5,53	4,98	16,19	14,17	10,89	10,78	12,71	14,96
Rentabilidade R$/Ha	3945,53	4063,48	3265,53	3982,79	3481,60	4198,86	-1123,05	-808,33	-35,71	-77,01	-723,27	-1279,25
(%) R$/há	41,15	41,50	36,82	40,26	37,23	40,46	-35,16%	-22,14%	-0,75%	-1,61%	-17,78%	-37,01%
Renda da Operação Agrícola – ROA R$/Ha	3945,53	4063,48	3265,53	3982,79	3481,60	4198,86	-1123,05	-808,33	-35,71	-77,01	-723,27	-1279,25
Custo Total – CT R$/Há	5642,95	5728,28	5602,23	5911,05	5870,16	6178,98	4317,08	4458,89	4783,59	4874,70	4792,18	4735,58
(%) R$/há	58,85	58,50	63,18	59,74	62,77	59,54	135,16	122,14	100,75	101,61	117,78	137,01
Ponto de Equilibrio – PE R$/Há	1111,07	1105,41	1212,28	1136,96	1209,36	1137,94	-2725,78	-6482,17	5100,05	5637,20	-10205,71	-2345,11

Source: prepared by the authors, 2023.

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The strict relationship between variable costs and fixed production costs on a gross income obtained through yield (sc/ha-¹) and marketed at a market price, determines a strategic reference point, the economic break-even point (BEP). The management treatment (A) presents BEP values close to and below 1000.00 R$/ha-in the corn and soybean crops, values that makeup profitability above 45% and 51% respectively. However, in the wheat crops, the BEP far exceeds 3000.00 R$/ha and the beans acted above 1500.00 R$/ha-¹, values that indicate a low profitability index.

Similarly, the management (C) presents break-even values corresponding to the management (A). However, in detriment to the high costs and variable costs of the chemical management (B), we observe that only soybeans and corn presented positive results, wheat and beans suffered great losses.

CONCLUSION

Economically, the financial results, especially the cost of production, were attractive on a scale of R$/ha-¹ in biological management (A) in corn, beans, and soybean crops. As well as the break-even point of the economic and financial results of the four crops evaluated, all being equivalent and positive in biological management (A).

Bioagricultural management (C), the integration between chemical/conventional and biological management, demonstrates greater technical and economic safety about abiotic factors, especially resilience to water stress, delivering superior results in profitability in the face of the present and future challenges of our agriculture.

The results of this study highlight the importance of the transition to agricultural management practices as an economically sustainable approach to annual agricultural production. This not only reduces dependence on external production factors but also promotes the profitability and quality of agricultural products. Therefore, agriculture and the use of biological resources are attractive options to face the challenges of food production in a constantly evolving world.

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REFERENCES

1. APROSOJA. (2021). Custo de produção - milho. https://aprosojams.org.br/sites/default/files/boletins/CUSTO%20DE%20PRODU%C3%87%C3%83O%20-%20MILHO%202021_3.pdf. Acesso em: 02 ago. 2023.

2. Artuzo, F. D., Foguesatto, C. R., & Silva, L. X. (2017). Agricultura de precisão: Inovação para a produção mundial. Revista Tecnologia e Sociedade. https://periodicos.utfpr.edu.br/rts/article/download/4755/4395. Acesso em: 05 maio 2021.

3. Bellé, L. A. (2021). Propriedades agronômicas da soja submetida à aplicação de doses de cama de aves e inoculação com Bradyrhizobium japonicum. Brazilian Journal of Development, 7(2). https://ojs.brazilianjournals.com.br/ojs/index.php/BRJD/article/view/25090/20002. Acesso em: 14 abr. 2023.

4. Brito, R. S., et al. (2019). Rochagem na agricultura: Importância e vantagens para adubação suplementar. AJEBTT, 6(1), Rio Branco, UFAC. https://periodicos.ufac.br/index.php/SAJEBTT/article/view/2331. Acesso em: 30 out. 2021.

5. Companhia Nacional de Abastecimento - CONAB. (2018). Acompanhamento da safra brasileira de grãos – Observatório agrícola (Vol. 12, safra 2017/2018). https://www.conab.gov.br/info-agro/safras/graos. Acesso em: 29 dez. 2018.

6. Embrapa. (2013). Sistema brasileiro de classificação do solo (Ed. 3). Brasília, DF. https://www.embrapa.br/busca-de-produtos-processos-e-servicos/-/produto-servico/1299/sistema-brasileiro-de-classificacao-de-solos---sibcs-3-edicao. Acesso em: 10 maio 2021.

7. EOS – Earth Observing System. (2019). NDVI FAQ: All you need to know about NDVI. https://eos.com/blog/ndvi-faq-all-you-need-to-know-about-ndvi/. Acesso em: 20 fev. 2023.

8. Fonseca, M. H. (2018). Gestão de custos na agricultura familiar na cidade de Ponta Grossa (Dissertação de Mestrado, Universidade Tecnológica Federal do Paraná). https://repositorio.utfpr.edu.br:8080/jspui/bitstream/1/3026/1/PG_PPGEP_M_Fonseca%2c%20Maria%20Helena%20da_2018.pdf. Acesso em: 18 maio 2021.

9. Lajús, C. R., et al. (2021). Aspectos qualitativos e quantitativos de variedades de alface submetidas a concentrações de pó de rocha em cultivo orgânico. Brazilian Journal of Development. https://www.brazilianjournals.com/index.php/BRJD/article/view/29933/23591. Acesso em: 02 dez. 2021.

10. Lourenzani, W. L., et al. (2012). Gestão da empresa rural: Uma abordagem sistêmica. http://www.gepai.dep.ufscar.br/pdfs/1102012100Lourenzani_SouzaBankutipdf. Acesso em: 20 ago. 2017.