

Ciências Agrárias

Organizadores

Alexandre Machado Fernandes
Frederico Fonseca da Silva
Paulinho Rene Stefanello
Luiz Panhoca
José Aguirre

Livro 1

Agronegócio
Nutrição de plantas
Fitotecnia
Nutrição de plantas
Energia / Biogás
Segurança no campo
Ambiental /
Saneamento Básico
Extensão Rural

Organizadores:

Alexandre Machado Fernandes - IFPR

Frederico Fonseca da Silva - IFPR

Paulinho Rene Stefanello - IFPR

Luiz Panhoca - UFPR

José Aguirre - UCM (Madri / Espanha)

Ciências Agrárias - Livro 1

EDITORA



FaCiência

Todos direitos reservados. Proibida a tradução, versão ou reprodução, mesmo que parcial, por quaisquer processos mecânicos, eletrônico, re-prográfico etc., sem a autorização por escrito do autor do artigo.

1ª edição junho de 2023

Registro de Direito Autoral DOI 10.29327/567563 (por artigo)

ISBN - 978-65-89779-06-3

Capa: Roberto Ari Guindani - <https://www.faciencia.edu.br/editora-faciencia>

Produção Editorial: *Ricardo Sterchele* - www.frontis.com.br

Editor-Chefe: Dr. Roberto Ari Guindani

Lattes iD - <http://lattes.cnpq.br/2938746639609983>

Orcid iD - <https://orcid.org/0000-0002-5600-5869>

Dados Internacionais de Catalogação na Publicação (CIP)
(Câmara Brasileira do Livro, SP, Brasil)

Coletânea universitária [livro eletrônico]: frutos das ciências contábeis e gestão pública / organizadores Alexandre Machado Fernandes, Frederico Fonseca da Silva, Paulinho Rene Stefanello, Luiz Panhoca, José Aguirre - 1. ed. - Curitiba/PR: Editora FaCiência, 2023.

ISBN 978-65-89779-06-3

1. Artigos - Coletâneas 2. Ciências contábeis 3. Gestão pública I. Fernandes, Alexandre Machado. II. Silva, Frederico Fonseca da. III. Stefanello, Paulinho Rene. IV. Panhoca, Luiz. V. Aguirre, José.

21-59384

CDD- B869.3



Apoio:
INSTITUTO 
Guindani

EDITORA  **FaCiência**

Sumário

Prefácio	6
A study on soybean: the evolution of GDP, harvests and the leader of the soybean segment listed on B3 commodity exchange between 2011 and 2021 in Brazil.	8
<i>Daniel Massakazu Onaka</i>	
<i>Frederico Fonseca da Silva</i>	
<i>Alexandre Machado Fernandes</i>	
<i>Luiz Panhoca</i>	
<i>Paulinho Rene Stephanello</i>	
CAPÍTULO 2	
Desenvolvimento inicial de bananeira sob diferentes tecnologias de fertilização	42
<i>Marvin de Bruns</i>	
<i>Uberson Boaretto Rossa</i>	
<i>Luciano Alves</i>	
CAPÍTULO 3	
Variações fitotécnicas em relação à densidade do milho híbrido CG 1024	75
<i>Carlos César Pavani</i>	
<i>Frederico Fonseca da Silva</i>	
<i>Vanderlei Bett</i>	
CAPÍTULO 4	
Adubação da cultivar biofortificada de mandioca BRS 397 com fertilizante de liberação lenta, convencional e orgânica . . .	95
<i>Dirceu Pelegrino Vieira</i>	
<i>Überson Boaretto Rossa</i>	
<i>Francisco José Montório Sobral</i>	
<i>Frederico Fonseca da Silva</i>	
<i>Daniel da Rosa Faria</i>	

CAPÍTULO 5

Potencial de geração de energia elétrica com o uso do biogás produzido através da biomassa gerada em uma coturnicultura com sistema de tratamento por lâmina d'água na zona rural de Massaranduba (SC) 116

Roosevelt Duarte Junior
Überson Boaretto Rossa
Cleder Alexandre Somensi
Dilamara Riva Scharf
Luana Marcele Chiarello

CAPÍTULO 6

Diretrizes para a formação do profissional de saúde e segurança ocupacional nas atividades da agropecuária e da agroindústria. 145

Antonio Nunes Barbosa Filho

CAPÍTULO 7

Comparativo dos indicadores do GRI nos relatórios de sustentabilidade das empresas estatais de saneamento de economia mista no Brasil 161

Gislaine D. Andrade
Helena B. dos Santos
Joelma V. P. Mendes
Thalya C. dos Santos
Luiz Panhoca

CAPÍTULO 8

Popularização da ciência agronômica: extensão rural em sistemas sustentáveis de produção agrícola 210

Leandro Paiola Albrecht
Alfredo Junior Paiola Albrecht
Laércio Augusto Pivetta

Prefácio

Aos leitores desse Livro 1 de Agro, agro no seu sentido mais amplo, de Agroecologia ao Agronegócio, da Agricultura familiar a Agroindústria, informo que se trata de um projeto desses cinco amigos organizadores que decidiram materializar os bons trabalhos de pesquisa e de extensão que costumam ficar perdidos “nas prateleiras” após esforços empreendidos para atenderem alguma etapa acadêmica, seja de graduação (dos famosos TCC’s); das monografias de especialização, MBA, *Lato sensu* ou similares; resultados de pesquisas de mestrado e afins.

Esse Livro 1 de Agro é continuação do que fora iniciado com trabalhos de Gestão Pública e Ciências Contábeis, que já está no seu terceiro volume e, se preparando para o Livro 4.

Por querer receber temas do amplo Agro, adotou-se a metodologia da Embrapa quando ainda publicava a sua revista de Pesquisa Agropecuária Brasileira, a famosa PAB, ainda na forma impressa onde, cada edição contemplava alguns temas do imenso universo Agro. Por isso que ao lado dos títulos no sumário, o leitor encontra a área correlata ao tema.

Esse Livro 1 abre em grande estilo, com um assunto do Agronegócio, escrito em inglês, pois visa, também, o público externo, sobre a movimentação e a importância da commodity soja na Bolsa de Mercadorias de São Paulo; suavemente passa para um tema no desenvolvimento de bananeiras sobre diferentes tecnologias de fertilização, desde o adubo orgânico até os de liberação lenta; o capítulo seguinte traz uma importante pesquisa sobre densidade do milho e a sua correlação com fatores fitotécnicos; o capítulo seguinte, semelhantemente à bananeira (capítulo 2), aborda importante estudo sobre adubação, de diferentes origens, da brasileiríssima

mandioca; o capítulo 5 agrega o novíssimo segmento do agronegócio na produção de energia, dessa vez oriundo da cultura de codornas; o capítulo seguinte o importante tema de se estar discutindo a segurança do trabalhador do segmento agro, seja nas atividades da agropecuária, como na agroindústria; o sétimo capítulo vai abordar análises e indicadores das empresas de saneamento básico no Brasil; e, por fim, sem desejar que se termine, pois já criamos e expectativa do Livro 2, um trabalho de extensão rural desenvolvido na região Oeste do Paraná, por professores da UFPR.

Assim, tenho certeza de que essa nova série Agro também veio para ficar, assim como a série de Gestão Pública e Ciências Contábeis. Creio que seja dessa forma que vai se fazendo Ciência e se consolidando como gerador de informações válidas para aprendizado, leitura e referências.

A todos, excelente “viagem” por esses mares e, de forma, já redundante, parabéns aos organizadores.

*Danielle Fonseca
Pedagoga e fã desse time*

CAPÍTULO 1

A study on soybean: the evolution of GDP, harvests and the leader of the soybean segment listed on B3 commodity exchange between 2011 and 2021 in Brazil

Daniel Massakazu Onaka¹
Frederico Fonseca da Silva²
Alexandre Machado Fernandes³
Luiz Panhoca⁴
Paulinho Rene Stephanello⁵

Abstract: Brazilian agribusiness is one of the main pillars of the economy, in this context soybean represents the product with the most impressive numbers, corresponding to 49% of the national grain production, being the main export product of Brazil and occupying the first place in world production. We can highlight soybean productivity as a determining factor of this success, even in the country where we find problems related to the high cost of fertil-

- 1 - Graduate student in Specialization in Business, Accounting and Tax Management, at IFPR, Federal Institute of Paraná Campus Curitiba. ORCID: 0009-0009-2724-616X, Lattes <https://lattes.cnpq.br/1039233602794476>, Email: onakadanielonaka@gmail.com
- 2 - Professor of Agribusiness, PhD in Irrigation and Environment. ORCID: 0000-0003-2817-6983. Email: prof.frederico.silva@gmail.com
- 3 - Professor of Accounting Sciences, Master Degree in Administration. ORCID: 0000-0002-1005-6169. Email: alexandre.fernandes@ifpr.edu.br
- 4 - Professor of Accounting Sciences, PhD in Controllershship and Accounting. ORCID: 0000-0002-0839-1611. Email: panhoca@ufpr.br
- 5 - Professor of Accounting Sciences, Master Degree in Governance and Sustainability. ORCID 0000-0002-0010-1720 E-mail: paulinho.stefanello@ifpr.edu.br

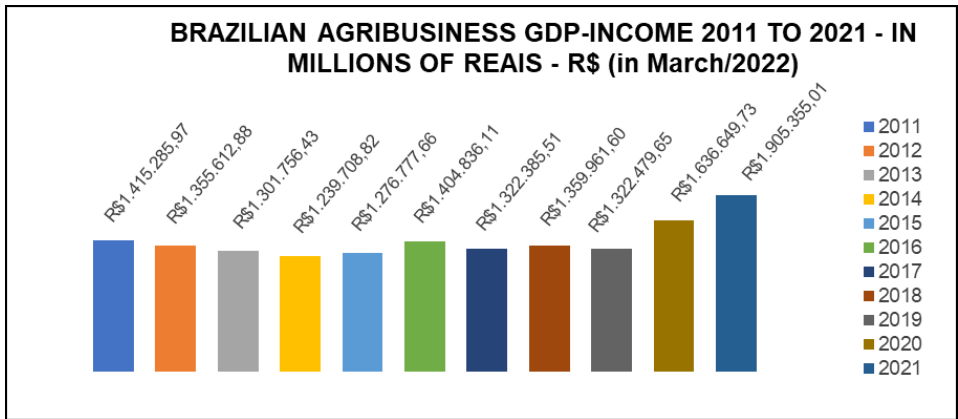
izers, the low participation of the government in financing and lack of infrastructure. The present study sought to describe, through bibliographic research and statistical tests, the importance of the soybean crop in the Brazilian economy and to correlate important variables. The results of the correlation between Agribusiness GDP x Crop were considered moderate, with the justification that only Soybean does not present the totality of wealth generated, Agribusiness GDP X Net Profit of the B3 company showed a moderate correlation, understanding that the wealth of the Agribusiness GDP and the wealth generated by the B3 Company's Net Income show different variations. But when we compare the Crop x Net Income of the B3 company, we find a strong correlation, in the sense that soybean is the main product of the B3 Company.

Keywords: Agribusiness, Exports, Production, Statistics.

UM ESTUDO SOBRE A SOJA: DA EVOLUÇÃO DO PIB, DAS SAFRAS E DA LÍDER DO SEGMENTO SOJA LISTADA NA B3 ENTRE 2011 E 2021 NO BRASIL

Resumo: O Agronegócio brasileiro é um dos principais pilares da economia, neste contexto a soja representa o produto com os números mais impressionantes, correspondendo a 49% da produção de grãos nacionais, sendo o principal produto de exportação do Brasil e ocupando a primeira colocação na produção mundial em 2022. Podemos destacar a produtividade da soja como um fator determinante desse sucesso, mesmo no país onde encontramos problemas ligados ao alto custo dos fertilizantes, a pouca participação do governo nos financiamentos e falta de infraestrutura. O presente estudo buscou descrever por meio de pesquisas bibliográficas e testes estatísticos, a importância da safra soja na economia brasileira e correlacionar variáveis importantes. Os resultados da correlação entre o PIB do Agronegócio x Safra foram consideradas moderada, com a justificativa de apenas a Soja não apresentar as totalidades de riquezas geradas, PIB do Agronegócio X Lucro Líquido da empresa da B3 apresentaram uma correlação moderada, entendendo-se que o as riquezas do PIB do Agronegócio e as riquezas geradas pelo Lucro Líquido da Empresa da B3 apresentam

Graph 2. Share of Agribusiness GDP: agricultural sector



Source: CEPEA/Esalq-USP (2023) - adapted by the authors (2023)

2.2 Evolution of the results of the Brazilian soybean crop

In 2011, the Brazilian soybean crop met approximately 23% of international demand and, in the previous 35 years, while the planted area grew by 248%, productivity in the same period grew by 506%. This increase in productivity is the result of investments in scientific research led by Embrapa, mainly in the genetic area, plant and soil improvement and nutrition. The entrepreneurship and creativity of the Brazilian producer also contributed a lot to these expressive results (SILVA NETO, 2011).

Data from 2020 show that the evolution of the planted area between 1990 and 2020 was 220.87%, while productivity in the same period was 501.6%, placing Brazil as the second largest producer of soybeans in the world in 2020, second only to the USA (SANTOS, 2020).

The USA, Brazil and Argentina account for 80% of the world's soybean production, and Brazil stands out for the highest production growth in the last three decades, with 5.9%, while the USA grew 2.7% and the Argentina grew by 1.6%. However, the profitability of Brazilian producers reached only 61.5% in the last 5 harvests

(20118-2022), well below Argentina, which obtained 146.4%, with this Brazilian result as its main villain: production costs (CANAL RURAL, 2022).

Observing in Table 1, the numbers presented arranged by the temporal arch 2011 to 2021, it is verified that the evolution of the planted area presented an increase of 65.5% of the 2021/2022 harvest in relation to the 2011/2012 harvest; an increase in productivity of 89.1% for the same period; an increase in quotation of 157.3%; and a 387.3% higher revenue.

Table 1. Soybean crop temporal arch – Period of 2011/2021

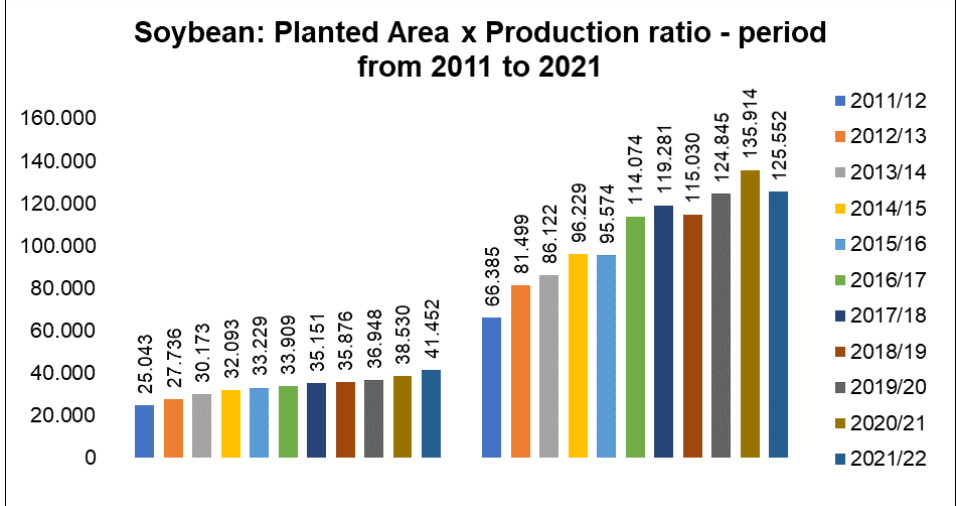
Agricultural Year	Planted Area (Millions of ha)	Sacks (of 60 Kg) Harvested	Price of Soy Sack (in Reais – R\$)	Annual Gross Revenue (In Reais – R\$)
2011/2012	25.043,00	1.106.416.667	69,01	76.353.814.166,67
2012/2013	27.736,00	1.358.316.667	67,25	91.346.795.833,33
2013/2014	30.173,00	1.435.366.667	72,65	104.279.388.333,33
2014/2015	32.093,00	1.603.816.667	81,50	130.711.058.333,33
2015/2016	33.229,00	1.592.900.000	71,30	113.573.770.000,00
2016/2017	33.909,00	1.901.233.333	84,43	160.521.130.333,33
2017/2018	35.151,00	1.988.016.667	82,17	163.355.329.500,00
2018/2019	35.876,00	1.917.166.667	121,23	232.418.115.000,00
2019/2020	36.948,00	2.080.750.000	170,07	353.873.152.500,00
2020/2021	38.530,00	2.265.233.333	188,89	427.879.924.333,33
2021/2022	41.452,00	2.092.538.333	177,82	372.095.166.433,33

Source: CONAB (2023) – adapted by the authors (2023)

Interpreting these numbers, it is observed that the soybean harvest between the years 2011 and 2021 gained productivity with the increase in production greater than that of the planted area, and increased pricing in the market when faced with the increase in quotation (Graph 3). Also noteworthy is the evolution of bag prices in the

period from 2018 to 2021, which showed a dissonant growth compared to previous years, this growth is mainly justified by the international market demand, contributing to the profitability of the product.

Graph 3. Soybean: Planted Area X Production (2011/2021 harvest period)



Source: CONAB (2023) – adapted by the authors (2023)

The representation presented in Graph 3 demonstrates how the evolution of production was higher than the planted area. Even with the increase in deforestation for the same period and the focus on sustainability, the challenge for producers and the government has been great for soy production and, it can signal that the work done to produce more without the need to increase the area planted has worked, showing very positive results.

2.3 Financial results of the leading company in the soybean segment listed on B3

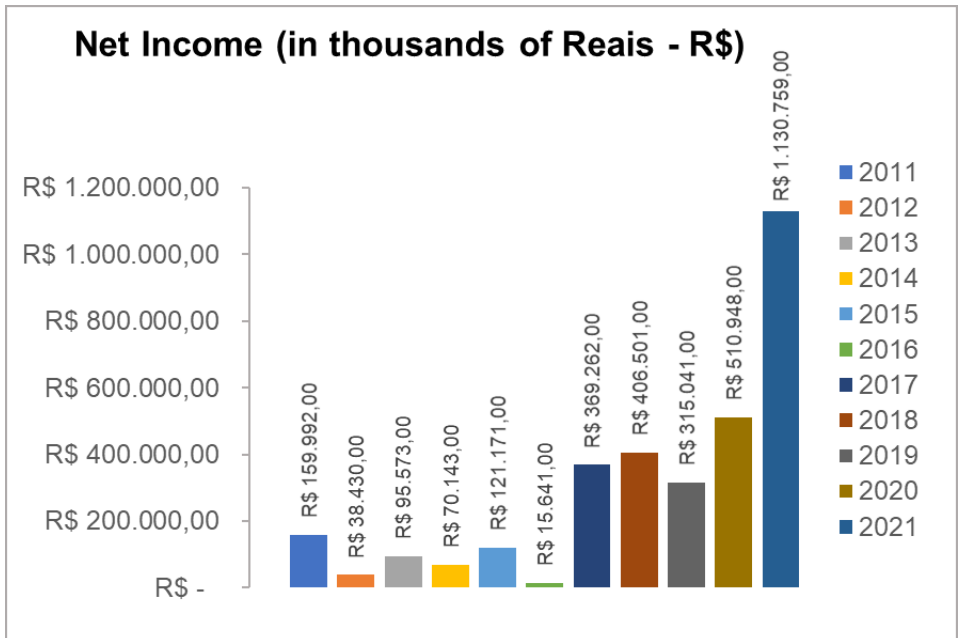
It can be understood that a company’s net profit is the key point to measure its performance and compose the basis for its pricing and its primary financial indicators (DA SILVA, FREIRE and DE MEDEIROS, 2020). The statement is justified by the net profit representing the result, after deducting all costs and expenses for the period,

thus qualifying and demonstrating its protagonism and importance (FRANCISCO and GALDI, 2022).

By definition, shareholders' equity represents the difference between Assets (assets and rights) and Liabilities (obligations) and transactions between partners and shareholders and comprehensive income (GONZALES and DOS SANTOS, 2018).

For the preparation of Graphs 4 and 5, figures were taken from the management reports presented by the leader of the soy segment at B3, relating to the temporal arch from 2011 to 2021, serving as an information base, the Net Income and the Shareholders' Equity of the organization.

Graph 4. Net Income of the Leading Company in the Soybean Segment at B3



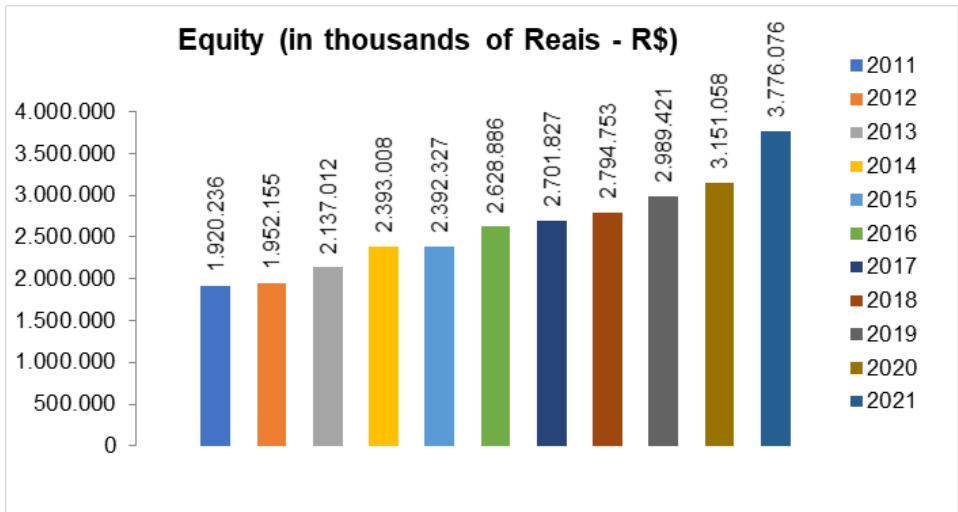
Source: Management Reports – Leader Company on B3 (SLC, 2011 to 2021) – adapted by the authors (2023)

The year 2021 stands out in Graphs 4 and 5 for presenting a dissonant evolution in values, but it is observed that in the report of

the directors of the leading company in the soybean segment at B3 (2021), there is a mention of the acquisition of two farms and that, from the second half of 2021, the results were incorporated into the Leader Company, but consulting the reports presented by the acquired farm, which had its profit incorporated, it was observed that the result was R\$ 19,752,000.00, that is, thus representing 1.7% of net income, which does not represent a distortion for the sample, being irrelevant in view of the 153% growth presented in the period 2021.

The growth is justified by the 4 pillars implemented, the important contracts for the growth of operations, advances in crop productivity, records in financial results and achievements that strengthened the ESG positioning internally and for the market, thus the significant increase in Net Income represented by Graph 4 is justified, and therefore it is not possible to suppress the result.

Graph 5. Shareholders' Equity Leading Company B3 Segment



Source: Management Reports – Leader Company on B3 (SLC, 2011 to 2021) – adapted by the authors (2023)

Regarding the increase in Shareholders' Equity (chart 5), the same report indicates a capital contribution of BRL 500 million approved by the shareholders, thus effecting the increase in Share Capital, and culminating in an increase in Shareholders' Equity (SLC, 2021).

[...] the classification of parametric or non-parametric refers to the type of statistical test, and not to the random variable. It is not correct to say that a specific variable is parametric or non-parametric.

To define the normality test, the following data are used, presented by Machado et al. (2014):

The most used statistical tests in the analyzed publications to test normality were Shapiro-Wilk (n=163) and Kolmogorov-Smirnov (n=137). These were responsible for 83.8% of the publications that mentioned testing the normality of their data. Still, 2.8% performed other tests and 13.4% did not specify which test was used, however, they claimed to test normality (MACHADO et al., 2014).

The Shapiro-Wilk normality test was applied to evaluate the sample regarding the type of distribution, whether normal or not. The numbers of the temporal arch from 2011 to 2021 were listed, in an increasing way, in an MS-EXCEL spreadsheet, the variables GDP of Agribusiness, Soybean Crop and Net Income B3.

From the listed data, a spreadsheet based on the Shapiro-Wilk formula was prepared (SHAPIRO-WILK, 1965):

$$W = \frac{\left(\sum_{i=1}^n a_i x_{(i)} \right)^2}{\sum_{i=1}^n (x_i - \bar{x})^2}$$

As a result, the test will return the W statistic, which will have an associated significance value: the p-value. To say that a distribution is normal, the p value needs to be greater than 0.05 or 5% which represents the ALPHA (SHAPIRO-WILK, 1965).

Based on the results presented, the most appropriate choice to relate the variables was Spearman's correlation, which is derived from Pearson's correlation, with a differential to be used between variables measured at an ordinal level and when the normality of the distribution cannot be attributed (JACK and FOX, 2004).

To confirm this choice, the main characteristics of this type of correlation are presented, which are: Variables measured at an ordinal level, and does not assume a linear correlation; e, when samples are small (< 30), or not normally distributed, this method should be used.

It is important to highlight that correlations of ordinal variables do not have equal interpretations for variables measured at interval level. They do not necessarily show a linear trend, but can be considered as indices of monotonicity, that is, for positive correlation increases, increases in the 'X' value correspond to increases in the 'Y' value; and, for negative coefficients, the opposite occurs (LIRA and CHAVES NETO, 2006).

Note that, in Spearman's proposed correlation coefficient, designated "Rho" and represented by ρ , each individual corresponds to a point defined by the values of both variables, which vary between -1 and +1. The closer it is to the extremes, the greater the association between the variables. The negative sign of the correlation means that the variables vary in the opposite direction, that is, the higher categories of a variable are associated with lower categories of the other variable, and the positive sign is the opposite.

The Spearman Correlation is based on variables measured in an ordinal way. Thus, to carry out the calculation, there is a need to elaborate a ranking, to establish the ordering and its peers.

Formula applied for the Spearman Correlation:

$$\rho = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$

Where:

ρ is the Spearman correlation coefficient

d is the difference between the sorts

n is the number of pairs of sorts

After performing the calculation, the relationship between the two variables can be easily observed through a scatter diagram or scatter plot, in which Cartesian coordinates are used to display the

values of a data set as a collection of points, in which the values of one variable are read on the horizontal axis (axis of the abscissas) and those of the other, on the vertical axis (axis of the ordinates) (SOUSA, 2019).

The correlated variables in this study were Agri GDP x SAFRA; CROP x Net Income of COMPANY B3; and, Agri GDP X Net Income of COMPANY B3. From the calculations performed, it was possible to identify elements and information that allowed the realization of analyzes and discussions.

4 Analyzes and discussions

Using as a basis CEPEA's historical GDP Worksheet (CEPEA, 2023), the historical series of soy presented by CONAB (2023) and the Management Reports of the leading company in the soy segment at B3 (SLC, 2011 to 2021), the Table 2 using the time frame from 2011 to 2021, which contains the values for the variables, thus seeking the correlation between them.

Table 2. Variable numbers

Year	GDP of the agricultural segment	Harvest	B3 Company's Net income
	(In millions of reais – R\$)		
2011	1.415.286	76.354	160
2012	1.355.613	91.347	38
2013	1.301.756	104.279	96
2014	1.239.709	130.711	70
2015	1.276.778	113.574	121
2016	1.404.836	160.521	16
2017	1.322.386	163.355	369
2018	1.359.962	232.418	407
2019	1.322.480	353.873	315
2020	1.636.650	427.880	511
2021	1.905.355	372.095	1.131

Source: Authors (2023)

Imagens demonstrativas de aspectos do experimento

Recebimento das mudas clonada da variedade Grand naine



Preparo do campo



Plantio



Mudas plantadas e identificadas



Mudas em desenvolvimento



Operações de roçada e coroamento



Mudas em desenvolvimento



Fertilização com NPK



Adubação com cama de ave



Bananeiras Grand naine



Mudas identificadas



Coleta de dados – Rizoma



Instrumentos para medição



Mudas preparadas para secagem



Secagem em forno a 65°C por 4 dias



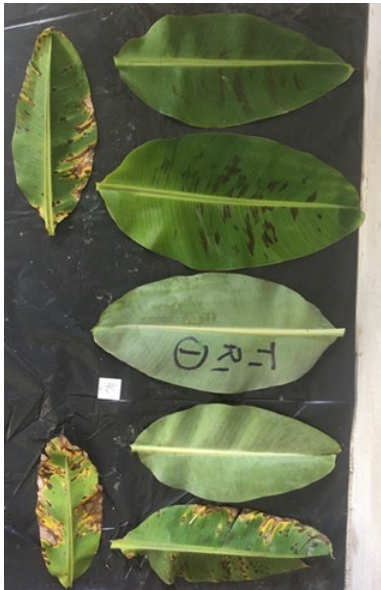
Separação de folhas



Folhas medidas e fotografadas



Separação de folhas



Determinação da área foliar por Image J

