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AGRONOMIC PROPERTIES OF SOYBEAN CROP MANAGED WITH MINERAL AND ORGANOMINERAL FERTILIZERS

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ABSTRACT

In its composition, the organomineral fertilizer has an organic fraction from industrial waste or agricultural activities, such as waste from poultry or pig farming. The present work aims to evaluate the agronomic properties of soybean crop managed with mineral and organomineral fertilizers. The experiment was implemented at the Agro Latina BR Experimental Station, located in the municipality of Guatambu/SC, in the 23/24 soybean harvest. The experimental design was the Randomized Block Design with 7 treatments and 4 replications, totaling 28 plots. The response variables evaluated were: Root volume and length at 5, 10, 20 and 30 days after emergence (DAE); Nodulation in V3 and R1; NDVI and SPAD in V3 and R1; Contents of macronutrients, micronutrients and enzymatic activity of the soil in pre-sowing and R1 via leaf analysis; Number of pods per plant, number of grains per pod, weight of 1000 grains and yield (kg/ha). Under the conditions in which the experiment was conducted, the results obtained allow us to conclude that: the dose of +25% Organomineral (05 15 15) differs provides the best results in relation to the qualitative (volume and root length; number of active nodules and SPAD reading) and quantitative (number of pods per plant; weight of one thousand grains and yield) response variables.

Keywords: Sustainability. Agronomic Properties. Organomineral Fertilizer.

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INTRODUCTION

The application of organomineral fertilizers in Brazilian agriculture has been increasing in recent years and is an alternative for fertilization in relation to the use of conventional fertilizers or mixtures of Nitrogen, Phosphorus and Potassium (N-P-K). In a world increasingly concerned with the demand for food, Brazil is one of the most relevant countries in this regard, but the country has structural deficiencies, since it does not have significant mines for the production of phosphorus and potassium, which prevent it from producing the main nutrients in order to adequately meet its demand. which today is the fourth largest on the planet (CRUZ, 2017).

The use of fertilizers and correctives has intensified in recent years, and in 2020 the Brazilian fertilizer market grew by about 12% compared to 2019. However, about 80% of the fertilizers consumed in Brazil are of foreign origin (ANDA, 2020). In order to increase the competitiveness of Brazilian agribusiness, the organomineral fertilizer sector emerges as an alternative for the supply of nutrients necessary for soil correction and plant nutrition.

In addition to the economic and strategic benefits for the country, the use of organomineral will reduce the environmental impacts derived from the incorrect disposal of waste from our livestock. For Scherer, Nesi and Massotti (2010), the production of organomineral fertilizers serves as an environmentally correct way of absorbing these wastes, reducing carbon emissions and improving the use of scarce natural resources. It is of great advantage to use raw materials and residues that are environmental liabilities of other production systems, which would be discarded in the environment without proper use (BENITES *et al*., 2010).

The main sources of raw material for the production of organominerals are agribusiness, livestock and households. In the agro-industrial sector, waste generation exceeded 291 million tons (IPEA, 2012) and the Brazilian livestock sector is the second largest on the planet, behind only the United States (MAPA, 2018), exposing that there is a large supply of raw material for the production of organomineral fertilizers.

In its composition, organomineral fertilizer has an organic fraction from industrial waste or agricultural activities, such as waste from poultry or pig farming. The organic fraction allows to take to the soil, in addition to macronutrients, micronutrients, organic carbon, humic and fulvic acids, which provide greater agronomic efficiency of these fertilizers, as they can reduce nutrient leaching and have less adsorption of phosphorus in the soil.

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The present research was carried out in an experimental area in the soybean crop in the 23/24 harvest in the municipality of Guatambu – SC, located in the western region of the State of Santa Catarina.

The guiding axes of the research will be: Soybean culture; Organomineral and mineral fertilization; Yield components. The research aims to evaluate the agronomic properties of soybean crops managed with mineral and organomineral fertilizers.

METHODOLOGY

CHARACTERIZATION OF THE RESEARCH ENVIRONMENT

The experiment was implemented at the Agro Latina BR Experimental Station, located in the municipality of Guatambu/SC, in the 23/24 soybean harvest.

According to Köppen's classification, the climate of the region is of the Cfa type, with average temperatures in the hottest months above 22°C and well-distributed precipitation (Agritempo, 2024).

The soil of the experimental area is classified as RED LATOSOL (Embrapa, 2013), Table 1 presents the analysis of the soil in pre-sowing of the soybean protocol.

Table 1 - Pre-sowing soil analysis of the soybean protocol

DETERMINAÇÕES			METODOLOGIA		
				1122	1122*
P	Fósforo (Mehlich)	mg/dm^3	Embrapa	2,4	--
M.O.	Matéria Orgânica	g/dm^3	IAC	36	--
COT	Carbono Orgânico Total	g/dm^3	IAC	21	--
pH	pH (CaCl2)	-	IAC	4,8	--
pH	pH (SMP)	-	IAC	5,78	--
K	Potássio (Resina)	mmolc/dm^3	IAC	4,9	--
Ca	Cálcio (Resina)	mmolc/dm^3	IAC	84	--
Mg	Magnésio (Resina)	mmolc/dm^3	IAC	31	--
Na	Sódio (Mehlich)	mmolc/dm^3	Embrapa	0,4	--
H^{+} + Al^{3}	Acidez Total	mmolc/dm^3	IAC	53	--
Al^{3}	Alumínio Trocável	mmolc/dm^3	IAC	0	--
H^{+}	Hidrogênio	mmolc/dm^3	Cálculo	53	--
C.T.C.	Capac. de troca de cátions	mmolc/dm^3	Embrapa	173,3	--
S.B.	Soma de bases	mmolc/dm^3	Cálculo	120,3	--
V%	Saturação por bases	%	Embrapa	69	--
m%	Saturação por Al	%	Embrapa	0	--
S	Enxofre (Fosfato de Cálcio)	mg/dm^3	IAC	10	--
B	Boro (Água Quente)	mg/dm^3	IAC	1,83	--
Cu	Cobre (Mehlich)	mg/dm^3	Embrapa	7,9	--
Fe	Ferro (Mehlich)	mg/dm^3	Embrapa	30	--
Mn	Manganês (Mehlich)	mg/dm^3	Embrapa	185	--
Zn	Zinco (Mehlich)	mg/dm^3	Embrapa	7,2	--
K na CTC	% de Potássio na CTC	%	Cálculo	2,8	--
Ca na CTC	% de Cálcio na CTC	%	Cálculo	48,5	--
Mg na CTC	% de Magnésio na CTC	%	Cálculo	17,9	--
Na na CTC	% de Sódio na C.T.C.	%	Cálculo	0,2	--
Al na CTC	% de Alumínio na CTC	%	Cálculo	0	--
H na CTC	% de Hidrogênio na CTC	%	Cálculo	30,6	--
H+AL na C	% de H^{+} + Al^{3} na C.T.C.	%	IAC	30,6	--
Ca/K	Relação Ca/K	-	Cálculo	17,1	--
Ca/Mg	Relação Ca/Mg	-	Cálculo	2,7	--
Mg/K	Relação Mg/K	-	Cálculo	6,3	--
Argila	Argila	g/kg	Método da Pipeta	329	--
Silte	Silte	g/kg	Método da Pipeta	322	--
Areia Total	Areia Total	g/kg	Método da Pipeta	349	--
B-glicosida	B-glicosidase	mg PNG/kg	ME MIC 07	--	70,52
Fosfatase /	Fosfatase Ácida	mg PNF/kg	ME MIC 07	--	577,56
Arilsulfatas	Arilsulfatase	mg PNS/kg	ME MIC 07	--	554,8

Source: prepared by the author, 2024.

RESEARCH STRATEGY AND DESIGN

The search strategy is organized as follows:

- Characterization of the research environment;
- Strategy and design of the research;
- Data collection techniques;
- Data analysis and interpretation techniques.

The research design is described as:

- As for the approach: it consists of a quantitative research;
- Regarding the focus: it consists of an explanatory research;
- Regarding the procedures, it consists of an experimental research.

DATA COLLECTION TECHNIQUES

Regarding the response variables (volume and root length), the experimental design used was Randomized Complete Blocks (DBC), in a Split-Plot Over Time (7X4) scheme, and fertilization was allocated in the Main Plot (PP1: Control (Mineral Fertilizer 02-20-20); PP2: Organomineral at the dose of the FQ (02-10-10); PP3: +25% Organomineral (02-10-10); PP4: -25% Organomineral (02-10-10); PP5: Organomineral in the Chemical Dose in kg (02-10-10) + Ca and Mg Oxide; PP6: +25% Organomineral Chemical Dose in kg (02-10-10) + Ca and Mg Oxide; PP7: -25% Organomineral Chemical Dose in kg (02-10-10) + Ca Oxide and Mg) and in the Subplot were allocated the days after emergence (SBP05, SBP10, SBP20 and SBP30 DAE), with four replications, totaling 112 plots, shown in Table 2.

Table 2 - Summary of the ANOVA of the Soybean Protocol, in relation to the response variables (volume and root length)

CAUSES OF VARIATION	GL
Blocks	3,00
PP: fertilizers	6,00
PP error: fertilization	18,00
SBP: DAE	3,00
PP (fertilizers) x SBP (DAE)	18,00
SBP Error: DAE	63,00
Total	111,00

Source: prepared by the author, 2024.

For the response variables (number of active nodules and weight of active nodules), the experimental design was Randomized Complete Blocks (DBC), in a Split-Plot scheme (7X2), and fertilization was allocated in the Main Plot (PP1: Control (Mineral Fertilizer 02-

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20-20); PP2: Organomineral at the dose of the FQ (02-10-10); PP3: +25% Organomineral (02-10-10); PP4: -25% Organomineral (02-10-10); PP5: Organomineral in the Chemical Dose in kg (02-10-10) + Ca and Mg Oxide; PP6: +25% Organomineral Chemical Dose in kg (02-10-10) + Ca and Mg Oxide; PP7: -25% Organomineral Chemical Dose in kg (02-10-10) + Ca Oxide and Mg) and in the Subplot the developmental stages (SBPV3 and SBPR1) were allocated, with four replications, totaling 56 plots, shown in Table 3.

Table 3 - Summary of the ANOVA of the Soybean Protocol, in relation to the response variables (number of active nodules and weight of active nodules)

CAUSES OF VARIATION	GL
Blocks	3,00
PP: fertilizers	6,00
PP error: fertilization	18,00
SBP: stages of development (DE)	1,00
PP (fertilizers) x SBP (ED)	6,00
SBP Error: ED	21,00
Total	55,00

Source: prepared by the author, 2024.

Regarding the response variables (*NDVI* and *SPAD),* the experimental design used was Randomized Complete Blocks (DBC), in a Split Plot scheme (7X2), and in the Main Plot the fertilizations were allocated (PP1: Control (Mineral Fertilizer 02-20-20); PP2: Organomineral at the dose of the FQ (02-10-10); PP3: +25% Organomineral (02-10-10); PP4: -25% Organomineral (02-10-10); PP5: Organomineral in the Chemical Dose in kg (02-10-10) + Ca and Mg Oxide; PP6: +25% Organomineral Chemical Dose in kg (02-10-10) + Ca and Mg Oxide; PP7: -25% Organomineral Chemical Dose in kg (02-10-10) + Ca Oxide and Mg) and in the Subplot the developmental stages (SBPV3 and SBPR1) were allocated, with four replications, totaling 56 plots, as shown in Table 4.

Table 4 - Summary of the ANOVA of the Soybean Protocol, in relation to the response variables (*NDVI* and *SPAD)*

CAUSES OF VARIATION	GL
Blocks	3,00
PP: fertilizers	6,00
PP error: fertilization	18,00
SBP: stages of development (DE)	1,00
PP (fertilizers) x SBP (ED)	6,00
SBP Error: ED	21,00
Total	55,00

Source: prepared by the author, 2024.

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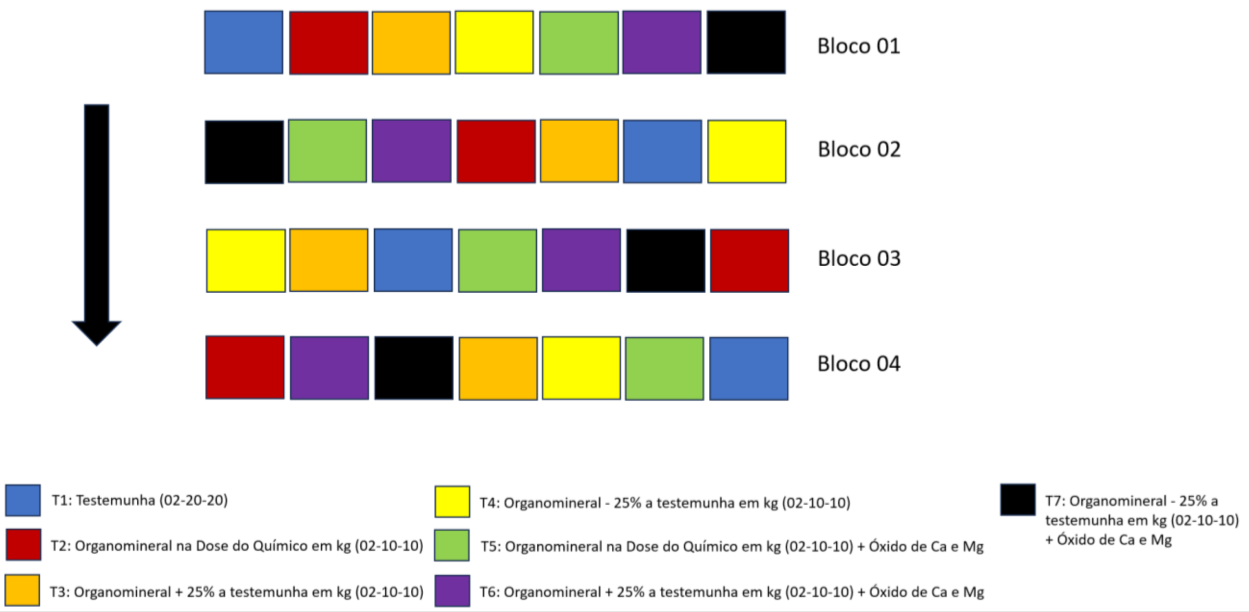
For the soybean yield components (number of pods per plant, number of grains per pod, weight per thousand grains and yield), the experimental design used was the Randomized Block Design with 7 treatments and 4 replications, totaling 28 plots, as shown in Figure 1. The total area of each plot is 36m2 (4.5 x 8 m, with 10 rows spaced 0.45 m apart), shown in Table 5.

Image 1 - Experimental design of the soybean protocol



Source: prepared by the author, 2024.

Table 5 - Summary of the ANOVA of the soybean protocol

CAUSES OF VARIATION	GL
Blocks	3
Treatments	6
Residue	18
Total	27

Source: prepared by the author, 2024.

The cultural treatments were carried out according to the needs of the crop presented in Chart 1 and the specificities of the treatments evaluated.

Table 1 - Phytosanitary treatments of the soybean protocol

Treatment	Product	Class	Dose per Hectare	Volume of Spray L./ hectare
Pre-sowing 30.11.2023	Glyphosate	Herbicide	3 l hectare	200
	Cletodim	Herbicide	1 l hectare	
	Mineral oil	Oil	100 ml hectare	
1 treatment (Cleansing) 06.01.2024	Glyphosate	Herbicide	2 l hectare	200
	Lambda-cyhalothrin + chlorantraniliprole	Insecticide	150 ml	

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	Oil	Oil	100 ml	
2 Treatments 26.01.2024	Carboxamide + TRiazole	Fungicide	750 ml	200
	Strobiruline	Fungicide	300 ml	
	Lufenuron	Insecticide	200 ml	
3 Treatments 20.02.2024	Morfoliin + Ketone	Fungicide	150 ml	150
	ACEPHATE	Insecticide	1.2 kg	
	Triazole	Fungicide	300 ml	
	Oil	Oil	100 ml	
	Boron + Manganese	Fert. Leaf	5 liters	
4 Treatments	Carboxamide + Strobiruline	Fungicide	750 ml	200
	Manganese	Fert. Leaf	4 liters	

Source: prepared by the author, 2024.

The response variables of the Soybean protocol were:

- Root volume and length at 5, 10, 20 and 30 days after emergence (DAE) (FLOSS, 2011);
- Nodulation in V3 and R1 according to the methodology of Milani *et al*., (2008);
- *NDVI* and *SPAD* in V3 and R1 according to Groff *et al*., (2013);
- Contents of macronutrients, micronutrients and enzymatic activity of the soil in pre-sowing and R1 via leaf analysis;
- Number of pods per plant, number of grains per pod, weight of 1000 grains and yield (kg/ha), were determined according to the methodology proposed by MAPA (2009).

TECHNIQUES FOR DATA ANALYSIS AND INTERPRETATION

The collected data were submitted to Analysis of Variance by the F Test (P≤0.05). Regarding the qualitative treatments, the differences between means were compared using Tukey's test (P≤0.05). For the quantitative treatments, regression analysis was performed, with the choice of mathematical models according to the significance and magnitude of the coefficient of determination (R2).

RESULTS

The Analysis of Variance (ANOVA) revealed a significant effect (P≤0.05) of the main plot (fertilizations) in relation to the root volume response variable, represented in Table 6.

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Table 6 - Main plot (fertilizations) in relation to the soybean root volume response variable (cm3)

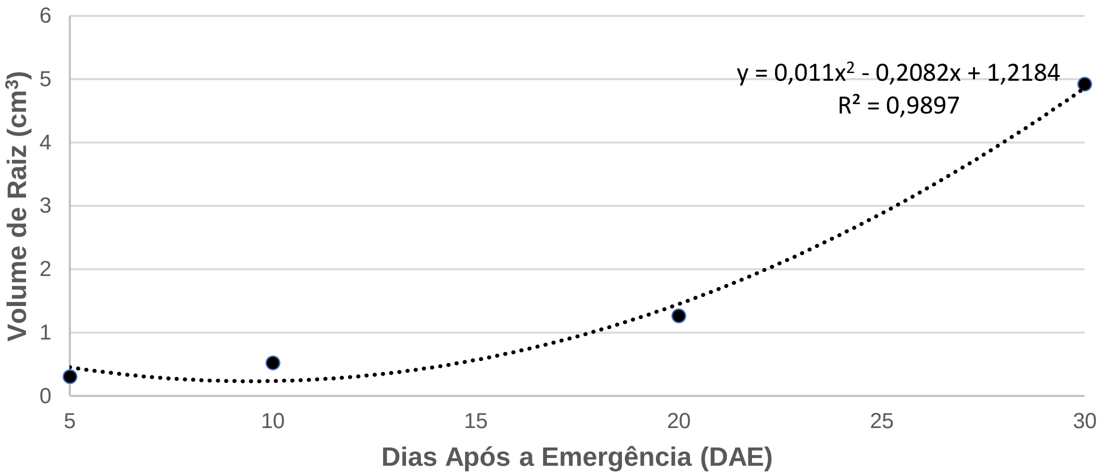
Parcela Principal: Adubações	Variável Resposta: Volume de Raiz (cm^3)
PP1: Testemunha (Fertilizante Mineral 02-20-20)	1,74 B
PP2: Organomineral na Dose do FQ (02-10-10)	1,83 B
PP3: +25% Organomineral (02-10-10)	2,17 A
PP4: -25% Organomineral (02-10-10)	1,43 C
PP5: Organomineral na Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	1,77 B
PP6: +25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	2,00 A
PP7: -25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	1,32 C
CV (%)	8,60

Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).

Source: prepared by the author, 2024.

ANOVA revealed a significant effect (P≤0.05) of the subplot (DAE) in relation to the response variable root volume, i.e., there is a mathematical model that explains the influence of the subplot (DAE) in relation to the response variable (soybean root volume), shown in Graph 1.

Graph 1 - Subplot (DAE) in relation to the soybean root volume response variable



Source: prepared by the author, 2024.

As shown in Graph 1, it can be seen that there was a cause-and-effect relationship between the subplot (DAE) and the response variable (soybean root length), i.e., the subplot (DAE) influences 98% of the soybean root length, presenting a quadratic behavior.

ANOVA revealed a significant effect (P≤0.05) of the main plot (fertilizations) in relation to the root length response variable, shown in Table 7.

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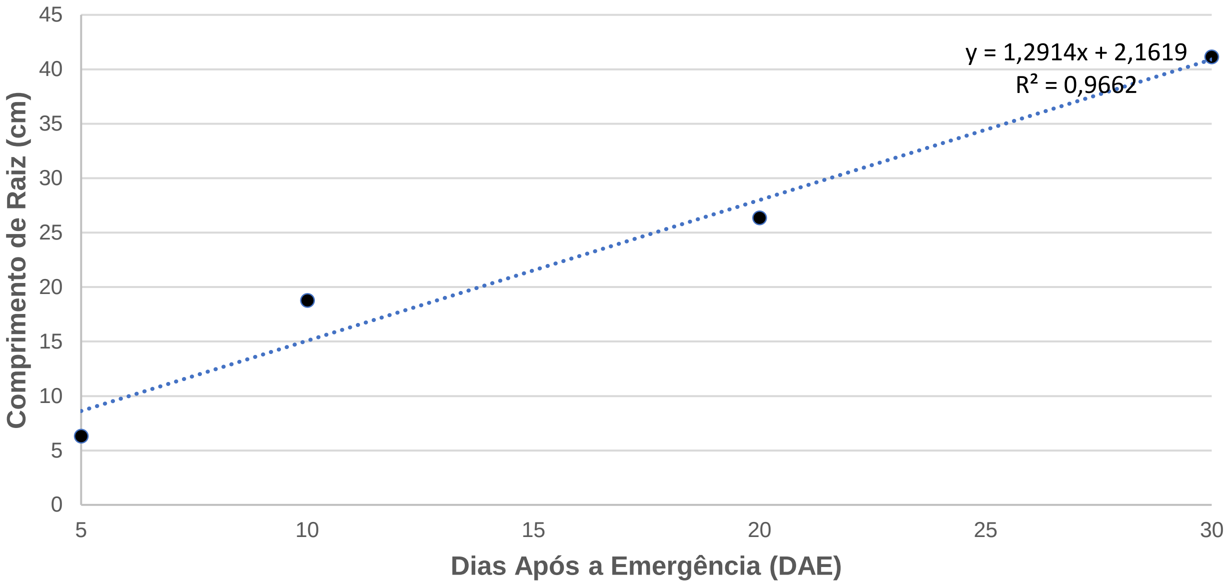
Table 7 - Main plot (fertilizations) in relation to the soybean root length (cm) response variable

Parcela Principal: Adubações	Variável Resposta: Comprimento de Raiz (cm)
PP1: Testemunha (Fertilizante Mineral 02-20-20)	21,03 D
PP2: Organomineral na Dose do FQ (02-10-10)	22,10 CD
PP3: +25% Organomineral (02-10-10)	24,29 B
PP4: -25% Organomineral (02-10-10)	21,07 CD
PP5: Organomineral na Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	24,82 AB
PP6: +25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	26,05 A
PP7: -25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	22,65 C
CV (%)	5,92
Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).	

Source: prepared by the author, 2024.

ANOVA revealed a significant effect (P≤0.05) of the subplot (DAE) in relation to the response variable root length, i.e., there is a mathematical model that explains the influence of the subplot (DAE) in relation to the response variable (soybean root length), as shown in Graph 2.

Graph 2 - Subplot (DAE) in relation to the response variable soybean root length



Source: prepared by the author, 2024.

According to Graph 2, it can be seen that there was a cause and effect relationship between the subplot (DAE) and the response variable (soybean root length), that is, the subplot (DAE) influences 96.62% of the soybean root length, presenting a linear behavior.

ANOVA revealed a significant effect (P≤0.05) of the main plot (fertilization) in relation to the response variable number of active nodules, presented in Table 8.

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Table 8 - Main plot (fertilization) in relation to the response variable number of active soybean nodules

Parcela Principal: Adubações	Variável Resposta: Nódulos Ativos (Número)
PP1: Testemunha (Fertilizante Mineral 02-20-20)	39,00 AB
PP2: Organomineral na Dose do FQ (02-10-10)	33,55 C
PP3: +25% Organomineral (02-10-10)	38,25 AB
PP4: -25% Organomineral (02-10-10)	39,50 A
PP5: Organomineral na Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	38,25 AB
PP6: +25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	39,50 A
PP7: -25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	35,35 BC
CV (%)	6,50
Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).	

Source: prepared by the author, 2024.

ANOVA revealed a significant effect (P≤0.05) of the subplot (developmental stages) in relation to the response variable number of active nodules, as shown in Table 9.

Table 9 - Subplot (stages of development) in relation to the response variable number of active nodules of soybean

Subparcela: Estádios de Desenvolvimento	Variável Resposta: Nódulos Ativos (Número)
V3	20,13 B
R1	55,13 A
CV (%)	12,50
Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).	

Source: prepared by the author, 2024.

ANOVA did not reveal a significant effect (P>0.05) of the main plot (fertilization) in relation to the variable weight response of the active nodules, presented in Table 10.

Table 10 - Main plot (fertilizations) in relation to the response variable weight of active soybean nodules

Parcela Principal: Adubações	Variável Resposta: Peso dos Nódulos Ativos (g)
PP1: Testemunha (Fertilizante Mineral 02-20-20)	4,11 A
PP2: Organomineral na Dose do FQ (02-10-10)	3,23 A
PP3: +25% Organomineral (02-10-10)	3,95 A
PP4: -25% Organomineral (02-10-10)	4,18 A
PP5: Organomineral na Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	3,95 A
PP6: +25% Organomineral na Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	4,18 A
PP7: -25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	3,18 A
CV (%)	7,09
Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).	

Source: prepared by the author, 2024.

ANOVA revealed a significant effect (P≤0.05) of the subplot (developmental stages) in relation to the response variable weight of active nodules, as shown in Table 11.

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Table 11 - Subplot (stages of development) in relation to the response variable weight of active soybean nodules

Subparcela: Estádios de Desenvolvimento	Variável Resposta: Peso dos Nódulos Ativos (g)
V3	2,05 B
R1	5,60 A
CV (%)	12,50

Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).

Source: prepared by the author, 2024.

ANOVA did not reveal a significant effect (P>0.05) of the main plot (fertilization) in relation to the response variable weight of the active nodules, shown in Table 12.

Table 12 - Main plot (fertilization) in relation to the *NDVI response variable*

Parcela Principal: Adubações	Variável Resposta: *NDVI*
PP1: Testemunha (Fertilizante Mineral 02-20-20)	0,84 A
PP2: Organomineral na Dose do FQ (02-10-10)	0,84 A
PP3: +25% Organomineral (02-10-10)	0,84 A
PP4: -25% Organomineral (02-10-10)	0,84 A
PP5: Organomineral na Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	0,84 A
PP6: +25% Organomineral na Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	0,85 A
PP7: -25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	0,84 A
CV (%)	2,76

Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).

Source: prepared by the author, 2024.

ANOVA revealed a significant effect (P≤0.05) of the subplot (developmental stages) in relation to the *NDVI response variable*, as shown in Table 13.

Table 13 - Subplot (stages of development) in relation to the NDVI response variable

Subparcela: Estádios de Desenvolvimento	Variável Resposta: *NDVI*
V3	0,82 B
R1	0,86 A
CV (%)	2,09

Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).

Source: prepared by the author, 2024.

ANOVA revealed a significant effect (P≤0.05) of the main plot (fertilization) in relation to the SPAD response variable, shown in Table 14.

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Table 14 - Main plot (fertilization) in relation to the *SPAD response variable*

Parcela Principal: Adubações	Variável Resposta: *SPAD*
PP1: Testemunha (Fertilizante Mineral 02-20-20)	42,96 B
PP2: Organomineral na Dose do FQ (02-10-10)	43,34 B
PP3: +25% Organomineral (02-10-10)	43,75 B
PP4: -25% Organomineral (02-10-10)	43,75 B
PP5: Organomineral na Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	43,86 B
PP6: +25% Organomineral na Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	46,99 A
PP7: -25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	42,21 B
CV (%)	9,01
Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).	

Source: prepared by the author, 2024.

ANOVA revealed a significant effect (P≤0.05) of the subplot (developmental stages) in relation to the SPAD response variable, shown in Table 15.

Table 15 - Subplot (stages of development) in relation to the SPAD response variable

Subparcela: Estádios de Desenvolvimento	Variável Resposta: *SPAD*
V3	42,46 B
R1	43,93 A
CV (%)	3,84
Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).	

Source: prepared by the author, 2024.

ANOVA revealed a significant effect (P≤0.05) of the treatments in relation to the response variable number of pods per plant, as shown in Table 16.

Table 16 - Treatments in relation to the response variable number of pods per plant

Tratamentos	Variável Resposta: Número de Vagens/Planta
T1: Testemunha (Fertilizante Mineral 02-20-20)	35,00 AB
T2: Organomineral na Dose do FQ (02-10-10)	35,00 AB
T3: +25% Organomineral (02-10-10)	35,09 AB
T4: -25% Organomineral (02-10-10)	32,91 B
T5: Organomineral na Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	35,89 A
T6: +25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	36,00 A
T7: -25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	33,09 B
CV (%)	3,43
Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).	

Source: prepared by the author, 2024.

ANOVA did not reveal a significant effect (P>0.05) of the treatments in relation to the response variable number of grains per pod, shown in Table 17.

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Table 17 - Treatments in relation to the response variable number of grains per pod

Tratamentos	Variável Resposta: Número de Grãos/Vagem
T1: Testemunha (Fertilizante Mineral 02-20-20)	3,00 A
T2: Organomineral na Dose do FQ (02-10-10)	3,00 A
T3: +25% Organomineral (02-10-10)	3,00 A
T4: -25% Organomineral (02-10-10)	3,00 A
T5: Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	3,00 A
T6: + 25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	3,00 A
T7: -25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	3,00 A
CV (%)	0,00
Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).	

Source: prepared by the author, 2024.

ANOVA revealed a significant effect (P≤0.05) of the treatments in relation to the response variable weight of one thousand grains, as shown in Table 18.

Table 18 - Treatments in relation to the response variable weight per thousand grains

Tratamentos	Variável Resposta: Peso de Mil Grãos (g)
T1: Testemunha (Fertilizante Mineral 02-20-20)	165,00 B
T2: Organomineral na Dose do FQ (02-10-10)	166,00 B
T3: +25% Organomineral (02-10-10)	175,00 A
T4: -25% Organomineral (02-10-10)	155,00 C
T5: Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	169,00 AB
T6: + 25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	175,80 A
T7: -25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	155,00 C
CV (%)	1,77
Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).	

Source: prepared by the author, 2024.

ANOVA revealed a significant effect (P≤0.05) of the treatments in relation to the yield response variable (kg/ha), shown in Table 19.

Table 19 - Treatments in relation to the yield response variable (kg/ha)

Tratamentos	Variável Resposta: Rendimento (kg/ha)
T1: Testemunha (Fertilizante Mineral 02-20-20)	3465,00 E
T2: Organomineral na Dose do FQ (02-10-10)	3486,00 D
T3: +25% Organomineral (02-10-10)	3712,00 B
T4: -25% Organomineral (02-10-10)	3036,00 G
T5: Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	3605,00 C
T6: + 25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	3802,00 A
T7: -25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	3102,00 F
CV (%)	1,01
Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).	

Source: prepared by the author, 2024.

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ANOVA revealed a significant effect (P≤0.05) of the treatments in relation to the yield response variable (sc/ha), shown in Table 20.

Table 20 - Treatments in relation to the yield response variable (sc/ha)

Tratamentos	Variável Resposta: Rendimento (sc/ha)
T1: Testemunha (Fertilizante Mineral 02-20-20)	57,75 E
T2: Organomineral na Dose do FQ (02-10-10)	58,10 D
T3: +25% Organomineral (02-10-10)	61,87 B
T4: -25% Organomineral (02-10-10)	50,60 G
T5: Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	60,08 C
T6: + 25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	63,37 A
T7: -25% Organomineral Dose do Químico em kg (02-10-10) + Óxido de Ca e Mg	51,70 F
CV (%)	1,01

Médias não seguidas de mesma letra diferem significativamente pelo Teste de Tukey (P≤0,05).

Source: prepared by the author, 2024.

DISCUSSION

The results obtained in relation to the qualitative and quantitative properties of the soybean crop corroborate studies carried out by Costa (2018), who evaluated the performance of the use of mineral and organomineral fertilizers in the respective crop. The work was carried out with different fertilizer dosages, following this description: T1: control (zero dose), T2: 200 kg/ha (Mineral), T3: 400 kg/ha (M), T4: 800 kg/ha (M), T5: 400 kg/ha (Organomineral), T6: 800 kg/ha (OM), T7: 1000 kg/ha (OM). The mineral fertilizer used was NPK (04-20-20) and organomineral (02-10-10), from the mixture of poultry litter, simple superphosphate, triple superphosphate and potassium chloride.

According to Carvalho *et al*. (2011), the increase in productivity in organomineral fertilization is the result of the increase in the concentration of organic radicals in the soil, which bind to nutrients, thus preventing nutrients from being leached and consequently having a longer retention time to the soil and availability for plants.

These results are in line with the study conducted by Cabral *et al*. (2020), in which it was inferred that the increase in fertilizer doses provided a linear increase in soybean grain yield, regardless of the sources of fertilizers used.

On the other hand, Ulsenheimer (2016) did not find a statistically significant difference in soybean yield between the treatments used with different doses and types of organomineral fertilizer in the soybean crop. It is only in the long term, with the continuous use of organomineral fertilizers, that there will be a decrease in the amount of fertilizer used, making only maintenance fertilizers necessary, since these fertilizers stimulate the proliferation of microorganisms, which carry out the mineralization of nutrients, making them available to the plants throughout their cycle (CASTANHEIRA; ROSEMARY; BELUTTIVOLTOLINI, 2015).

Based on these studies, it is concluded that organomineral fertilizer offers an alternative to traditional soybean crop management, offering greater sustainability, restructuring and enriching the soil by the proliferation of microorganisms. According to Cruz (2017), between 2000 and 2015, the use of fertilizers in the country grew by 87%, contributing, in part, to the significant increase in grain production in the country, in the same period, of 150%. However, the national production of fertilizers is historically lower than the national demand and did not show growth similar to that of demand. Therefore, new research is needed to create ways to convert industrial and urban waste into fertilizers.

CONCLUSION

Under the conditions in which the experiment was conducted, the results obtained allow us to conclude that the dose of +25% Organomineral (05 15 15) differs significantly from the others and provides the best results in relation to the qualitative (volume and root length; number of active nodules and SPAD reading) and quantitative (number of pods per plant; weight of a thousand grains and yield) response variables.

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REFERENCES

1. Agritempo. **Agroecological monitoring system**. 2024.

2. ANDA, National Association for the Diffusion of Fertilizers. **Main indicators of the fertilizer sector**. ANDA, 2020.

3. Benites, V. de M. *et al*. Production of granular organomineral fertilizer from pig and poultry manure in Brazil. In: FERTBIO, Guarapari. **Electronic annals...** Guarapari, 2010.

4. Cabral, F. L. *et al*., Evaluation of mineral and organomineral fertilization in soybean crop. Research, **Society and Development**, v. 9, n. 9. 2020.

5. Carvalho, E. R. *et al*. Mineral fertilizer and organic residue on soybean agronomic characteristics and soil nutrients. **Revista Ciência Agronômica**, v. 42, n. 4, p. 930-939, Oct-Dec, 2011.

6. Castanheira, T. D.; Rosemary, from O. A.; Beluttivoltolini, G. Organominerals: sustainability and nutrition for the soil. **Campo & Negócios Grãos Magazine**, Uberlândia, 2015.

7. Costa, F. K. D. *et al*. Agronomic performance of conventional soybean grown with organomineral and mineral fertilizers. **Nucleus**, v. 15, n. 2, 2018.

8. Cruz, A. C. *et al*. Organomineral fertilizers from agribusiness residues: evaluation of the Brazilian economic potential. Chemical Industry **| BNDES Setorial**, v. 45, p. 137-187. 2017.

9. Embrapa. Brazilian Agricultural Research Corporation. **Brazilian soil classification system**. Ed. 3, Brasília, DF. 2013.

10. Floss, E. L. **Physiology of cultivated plants:** the study of what is behind what is seen. 5. ed. Passo Fundo: UPF, 2011.

11. Groff, E. C. *et al*. Agronomic traits associated with vegetation indices measured by active canopy sensors in soybean crop. **Semina**: Agrarian Sciences, Londrina, v. 34, n. 2, p. 517-526, mar./apr. 2013.

12. IPEA, Institute of Applied Economic Research. **Diagnosis of organic waste from the agrosilvopastoral sector and associated agroindustries**. Brazil, 2012.

13. MAPA, Ministry of Agriculture, Livestock and Supply. **Low-carbon livestock**. Brasília: Mapa, 2018.

14. Map. Ministry of Agriculture, Livestock and Supply. **Rules for seed analysis.** Brasília: Mapa/ACS, 2009.

Revista ARACÊ
ISSN: 2358-2472

15. Milani, G. L. *et al*. Nodulation and development of plants from soybean seeds with high molybdenum contents. **Revista Brasileira de Sementes**, v. 30, n. 2, p. 19-27, 2008.

16. Scherer, E. E.; Nesi, N. C.; Massotti, Z. Soil chemical attributes influenced by successive applications of swine manure in agricultural areas of Santa Catarina. **Brazilian Journal of Soil Sciences**. 1375 - 1383 p. 2010.

17. Ulsenheimer, A. M. *et al*. Formulation of Organomineral Fertilizers and Productivity Test. **Unoesc & Ciência – ACET,** Joaçaba, v. 7, n. 2, p. 195-202, jul./dez. 2016.