Cattle manure alters the nutritional status and soybean yield (*Glycine max* L. Merr.)

ABSTRACT

Soybean is one of the most important crops globally, despite significant numbers the crop in the Cerrado biome presents low natural fertility with a higher demand for fertilization. Seeking to improve the production of culture by reducing costs there is the possibility of using organic waste, which can be a very advantageous and interesting option when well used. The objective of this work was to evaluate the physiological, nutritional, and productive aspects of soybean crops grown with cattle manure associated with chemical fertilizers. The experimental design was in randomized blocks with eight replications (4 for destructive analyses and 4 for grain harvesting). The treatments were composed of 5 doses of cattle manure (0.0, 2.5, 5.0, 10.0, and 20.0 t ha^{-1}) and control treatment (Control) without fertilization, without the use of manure and mineral fertilizer. The cattle manure provided a positive increase in the increase of levels of Ca, Mg, M.O, P, K, Fe, Zn and in the characteristics of plant height, stem diameter, soybean node number, dry weight of shoot, Falker chlorophyll index, root length and dry weight of root. The dose of 20.0 t ha^{-1} was the best response dose for soil nutritional conditioning for both physical and chemical characteristics, with an average increase of 68.26% in a comparison with only the use of conventional mineral fertilization.

Keywords: fertilizers, organic matter, production, nutrition.

1. INTRODUCTION

Brazil has the second-largest cattle herd in the world, with a reach of 218.2 million head of cattle, second only to India [1]. The daily production of manure (feces and urine) of an animal unit (AU = 450 kg live weight) is approximately 10% of its body weight, which represents, in most cases, an amount of approximately 40 to 45 kg/AU/day [2]. The accumulation of fertilizers in organic form can generate a great environmental impact, is largely caused by the lack of technical criteria for the recommendation of fertilization to the system, associated with long application time and high concentrations used at once which can generate saturation of the adsorption sites by this element, resulting in a lower p adsorption capacity in the profile, as well as decreases the binding energy that P does with soil colloids, which increases desorption, availability to plants and enhances phosphorus transfers by surface runoff and per growth [3]. However, it should be highlighted that the application of animal manure and inorganic fertilizer, when done correctly, has a great potential for long-term soil productivity and carbon fixation, and it also helps in maintaining grain yield in soils affected by erosive processes [4]. According to [5] cattle manure increases levels of organic carbon, total nitrogen, aggregate stability, water retention, and infiltration.

Soybeans is often limited by high production costs, between 23 and 27% in the total cost varying with each crop, and most of the fertilizer acquired in Brazil is through import, where preliminary data show that from January to May 2018, a total of 8,289,000 tons and in the previous year 34,439,000 tons of fertilizers were delivered to the Brazilian market [6]. Seeking to improve the production of soybean crops sustainably to reduce and optimize the use of fertilizers, the country should pay close use to soil fertilization alternatives, considering that in many regions there is the possibility of using organic waste, which can be a very advantageous and interesting option when well used.

The objective of this study was to evaluate the use of cattle manure associated with chemical fertilizers on the physiological, nutritional, and productive aspects of the soybean crop.

2. MATERIAL AND METHODS

The experiment was conducted in a greenhouse in the experimental area of the Federal University of Tocantins (UFT), Gurupi University Campus.**During summer two seasons (202--- and 202 --)**. The area is located at the coordinates of 11°43'45" S and 49°04'07" W, at 280 m altitudes in the south of the state of Tocantins. The regional climate is of type B1wA'a' humid with moderate water deficiency [7]. The experimental design was in randomized blocks with eight replications (four for destructive analyses, leaf analysis, and four for grain harvest, to quantify crop yield). The treatments were composed of five doses of cattle manure (0, 2.5, 5, 10, and 20 t ha^{-1}) and control treatment (Control), without fertilization.

The experimental units (EU) consisted of plastic vessels filled with 6.0 dm^3 of soil in the form of fine air-dried earth (TFSA). Soil samples collected from the 0 to 20 cm depth layer of a Red-Yellow Latosol (LvA) were sent to the Soil Laboratory (LABSOLO) of the Federal University of Tocantins/Gurupi for chemical and textural characterization according to the methodology recommended by [8] (Tabela 1). **Soil textural (sandy clay) .**

Wher soil salinity (EC) detremantion

Table 1. Chemical and textural characterization of the Red-Yellow Latosol. Gurupi – TO.

Ca^{2+}	Mg^{2+}	Al^{3+}	H+Al	CTC(T)	SB	CTC(t)	P	K
---cmol$_c$.dm^{-3}---							----mg.dm^{-3}----	
0.66	0.43	0.12	2.78	3.92	1.14	1.28	0.59	19.93
V	**m**	**Org. Mat**	**pH H_2O**	**Sand**	**Silt**	**Argil**		
------(%)------		-------%-------		-------------Textura (%)-------------				
29.10	9.52	2.57	5.01	49.01	13.60	37.39		

Based on the results of the analysis and the recommendation for correction of acidity and fertility level required, the soil was corrected and incubated for 20 days with 3.0 t ha^{-1} limestone (PRNT 100%) and 1.8 t ha^{-1} of gypsum before the beginning of the experiment. The chemical fertilization was 100 kg ha^{-1} of P_2O_5 and 100 kg ha^{-1} of K_2O for corrective fertilization and 120 kg ha^{-1} of P_2O_5 and 120 kg ha^{-1} of K_2O for crop maintenance and the corrective was incorporated soil and maintenance only in the 10 cm layer according to technical recommendations [9].

The cattle manure used was collected in the Grasu Agrobusiness© confinement, located in the municipality of Luís Eduardo Magalhães - BA, and its chemical and physical characterization was performed according to [8] (Tabela 2).

Table 2. Chemical characterization of cattle manure. Gurupi – TO.

N	P	K	Ca^{2+}	Mg^{2+}	Org.Mat	pH CaCl
------------------------- (%) -------------------------						
0.43	0.9	1.41	1.32	0.31	7.39	8.60

Cu	Fe	Zn	Mn
------------------------- mg dm^{-3} -------------------------			
20	4763	135	53

Soybean seeds 8579 RSF IPRO – IPRO Brasmax© BONUS per EU were sowed, and the cultivar was selected for being well adapted to the climate and region. Thinning was performed **21 days** after planting, keeping two plants per pot until the end of the experiment. Daily, the EU was irrigated with a manual watering can to keep moisture close to field capacity and cultural treatments were carried out throughout the production cycle, as recommended for the crop, and pest control is performed manually.

2.1 Morphological and yield characteristics

In phenological stage V3 [10], four replications of each treatment were aimed at evaluating the variable dry weight of shoot (DWS) to analyze crop growth by calculating growth rates. In R2, in the destructive repetitions, the following were determined: Falker Chlorophyll Index (FCI), node number (NN), root length (CR, cm), dry weight of shoot (DWS, g vase^{-1}), and dry weight of root (DWR, g vase^{-1}), absolute growth rate [AGR = (P2 – P1)/(t2 – t1), where P2 and P1 are the dry biomasses of two successive samplings, t2 and t1 are the days elapsed between the two observations] and relative growth rate [RGR = (LnP2 – LnP1)/(t2 – t1)].

For the determination of DWS and DWR, they were individually packed in paper bags and kept in a forced ventilation oven at 65°C for 72 hours, and subsequently weighed.

In the third completely expanded tube from apex to base, the Falker Chlorophyll Index (FCI) was quantified by a chlorophyll meter ClorofiLOG® model CFL 1030, which provides results in dimensional units [11].

the plants reached the phenological stage R8, plant height (PH, cm) stem diameter (SD, mm), soybean pods (SP), and grain number (GN) were measured. The grains were dried until reaching moisture of 13%, following criteria suggested by [12] then determined weight of one thousand grains (WTG) and grain production (GP).

2.2 Leaf nutrient contents

For the characterization of leaf nutritional status, total nitrogen (dag kg^{-1}) was analyzed by the Kjeldahl method [13] other foliar nutrients were extracted by acid digestion [14] the total levels of Ca, Mg, Fe, Mn, and Zn are determined by atomic absorption spectrophotometry and P and K by flame emission spectrometry.

2.3 Chemical analysis of the soil at the end of the experiment

Soil nutrient analyses, pH, H+Al, Al, M.O. parameters were performed according to the methodology proposed by [8]. The determination of P and K was performed by the procedure where 10 g of soil (TFSA) is used, adding 100 mL of extracting solution Mehlich I (HCl 0.05 mol L^{-1}) and then left to rest for 16 h. After this period, it was pipetted without filtering 25 mL of the extractor and passed to a plastic container, where 5.0 mL of this extractor was destined for P and the remainder for K determination [8].

2.4 Statistical analysis

The data were submitted for analysis of variance (p≤ 0.05) and regression through the software R® version 4.1 [15], multivariate analysis, using principal component analysis (PCA), and the preparation of the graphs were carried out in the software R® and by the software Sigmaplot® version 10 [16].

3. RESULTS

Effect of cattle manure application on soybean productivity.

Data show in Table (3) reaveld that the use of cattle manure promoted significant effects ($p \leq 0.05$) on soybean development, which was directly reflected in plant morphology and yield. The representation of the variance analysis for the different doses showed that there was no effect of the treatments only for the PH variable, thus having significant responses in the other variables (Table 3).

Table 3. Analysis of variance for evaluations: Plant height (PH), stem diameter (SD), soybean node number (NN), dry weight of shoot (DWS), root length (RL), dry weight of root (DWR), absolute growth rate (AGR), relative growth rate (RGR), Falker chlorophyll index (FCI), soybean grains number (GN), soybean pod number (SP), weight thousand grains (GW), grain productivity (GP) of soybean cultivar 8579 RSF IPRO - IPRO BONUS, submitted to cattle manure doses, Gurupi - TO.

Evaluations	Source of variation		Average	CV (%)
	Doses (D)	Residual		
	Degrees of freedom			
	4	15		
PH	8.452ns	18.841	48.05	3.10
SD	1.16**	0.0083	3.98	2.21
NN	3.175**	0.333	7.69	7.04
DWS	3.47**	0.011	2.29	4.13
RL	198.28*	63.109	56.87	13.77
DWR	0.35*	0.0078	1.26	6.42
AGR	0.017**	0.000044	0.12	4.92
RGR	0.0030**	0.00014	0.10	11.13
FCI	9.27**	2.211	45.74	3.22
GN	384.5**	9.07	86.25	3.50
SP	206.45**	3.783	47.58	3.98
GW	16.63**	1.792	19.72	6.65
GP	28.72**	0.172	18.06	2.20

**Significant by F-test analysis ($p<0.01$); *Significant by t-test analysis ($p<0.05$); ns non-significant by t-test analysis; CV: Coefficient of Variation.

However, the increase in doses promoted a positive linear response in the SD, NN, DWS, RL, DWR (Fig 1 B, C, D, E e F), for these characteristics, the best dose found by adjusting the equation was 20.0 ($t\ ha^{-1}$) manure, in the variable stem diameter (SD), with 4.85 mm with a difference of 47.71% compared to the control 3.28 mm, and 34.02% about the dose 0.0 $t\ ha^{-1}$ with 3.62 mm.

For the variable node number (NN), the best result was 9.50 nodes being a difference of 52% compared to the control 6.25 nodes, and 15.15% compared to the dose of 0.0 $t\ ha^{-1}$ with 8.25 nodes. The characteristic dry weight the shoot (DWS) obtained a response of 4.63 g, where its weight was

300.87% higher when compared with the control (1.16g) and approximately 190% about the dose of 0.0 t ha^{-1} (1.60g)

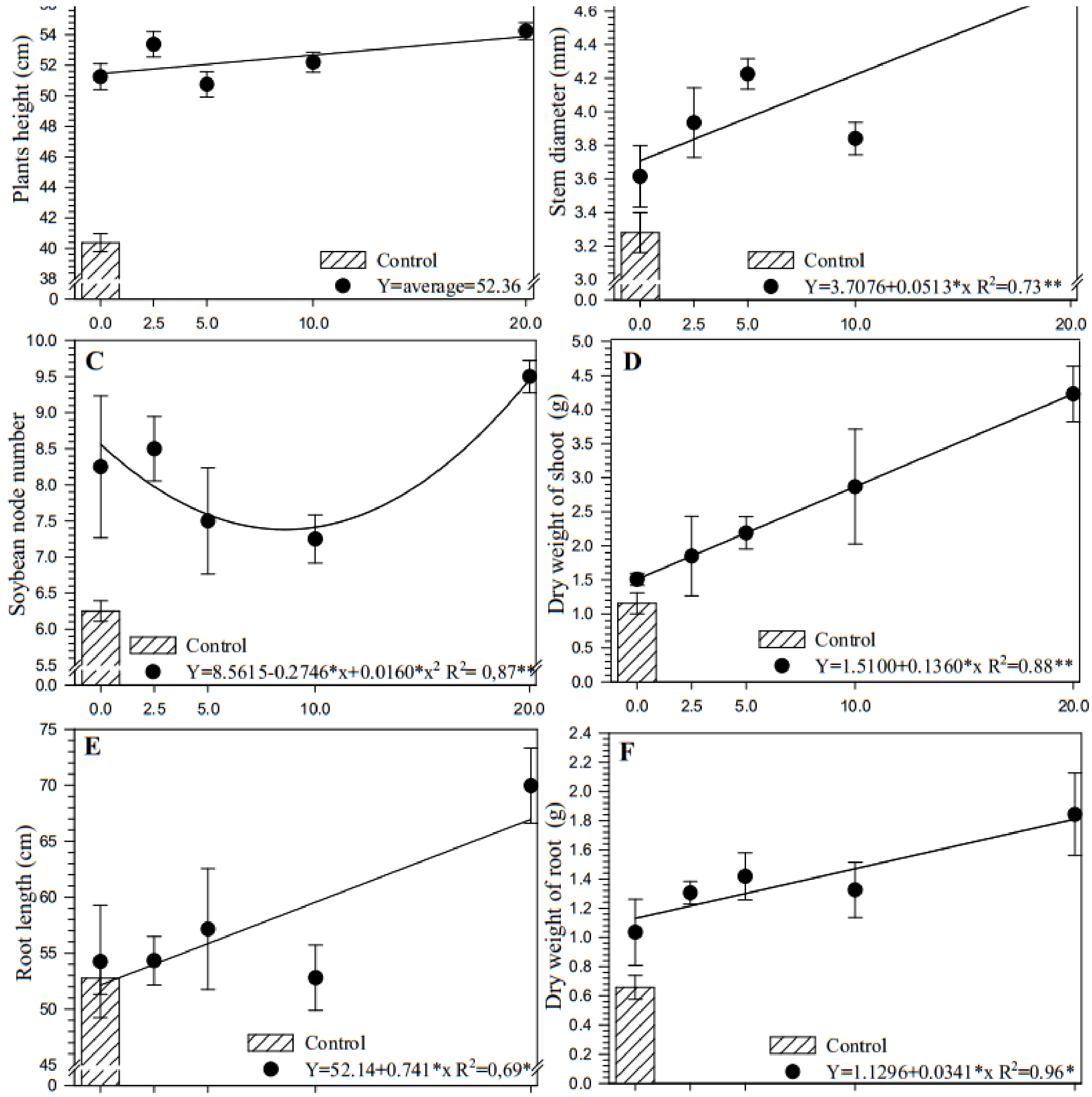

Fig. 1. Plants height (A), stem diameter (B), Soybean node number (C), dry weight of shoot (D), root length (E), dry weight of root (F), of soybean cultivar 8579 RSF IPRO - IPRO BONUS, submitted to cattle manure doses, Gurupi - TO.

In the root length feature (RL), the highest dose was replaced by 70.50 cm and 33.65% higher than the control 52.75 cm and 33.02% higher than the dose of 0.0 t ha^{-1} with 53 cm in length, respectively. the variable dry weight of root (DWR) the highest response was 1.84g, 180.23, and 78.02% better than the control treatment (0.66g) and the dose 0.0 t ha^{-1} (1,035g) respectively.

The characteristics AGR, RGR, and FCI showed a significant linear response when submitted to increasing doses of manure, and for these characteristics, the highest response with a dose of 20.0 t ha^{-1} with responses of (0.25) AGR, (0.15) RGR and (48.50) FCI), which make them 211.93, 125.86 and 8.97% higher when compared to the dose of 0.0 t ha^{-1}, and 325.26, 107.17 and 9.95% higher about the control (Fig. 2).

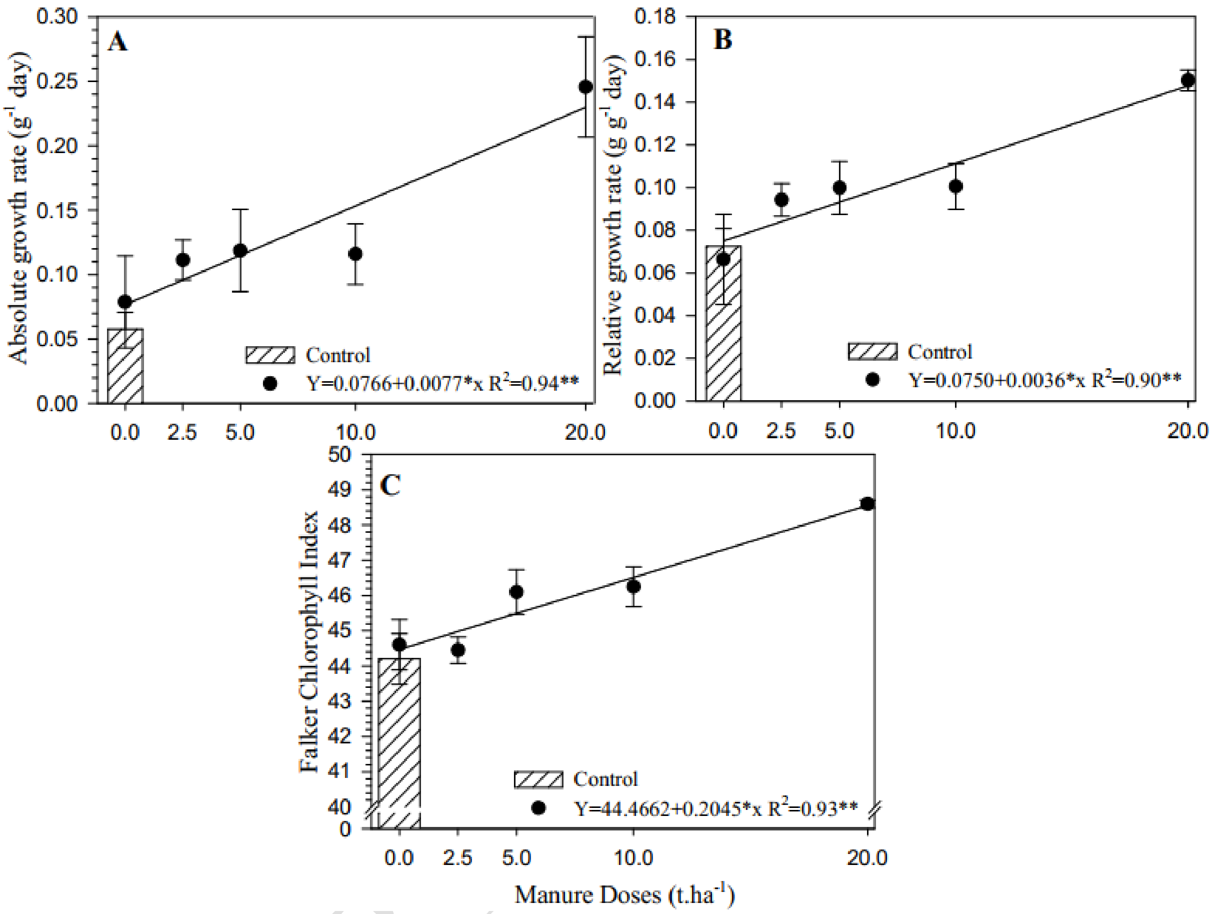

Fig. 2. Absolute growth rate (A), relative growth rate (B), Falker chlorophyll index (C) of soybean cultivar 8579 RSF IPRO - BONUS IPRO, submitted to cattle manure doses, Gurupi-TO. 2021.

The soybean grains number characteristics (GN) and grain productivity (GP) presented significant linear responses regarding the use of cattle manure (Fig. 3A and D), with the response of 110.50 grains and a yield of 68.37 sc.ha^{-1}, increasing 68.70 and 81.04% when compared to the control respectively and 27.01 and 35.84% about the dose 0.0 t.ha^{-1}.

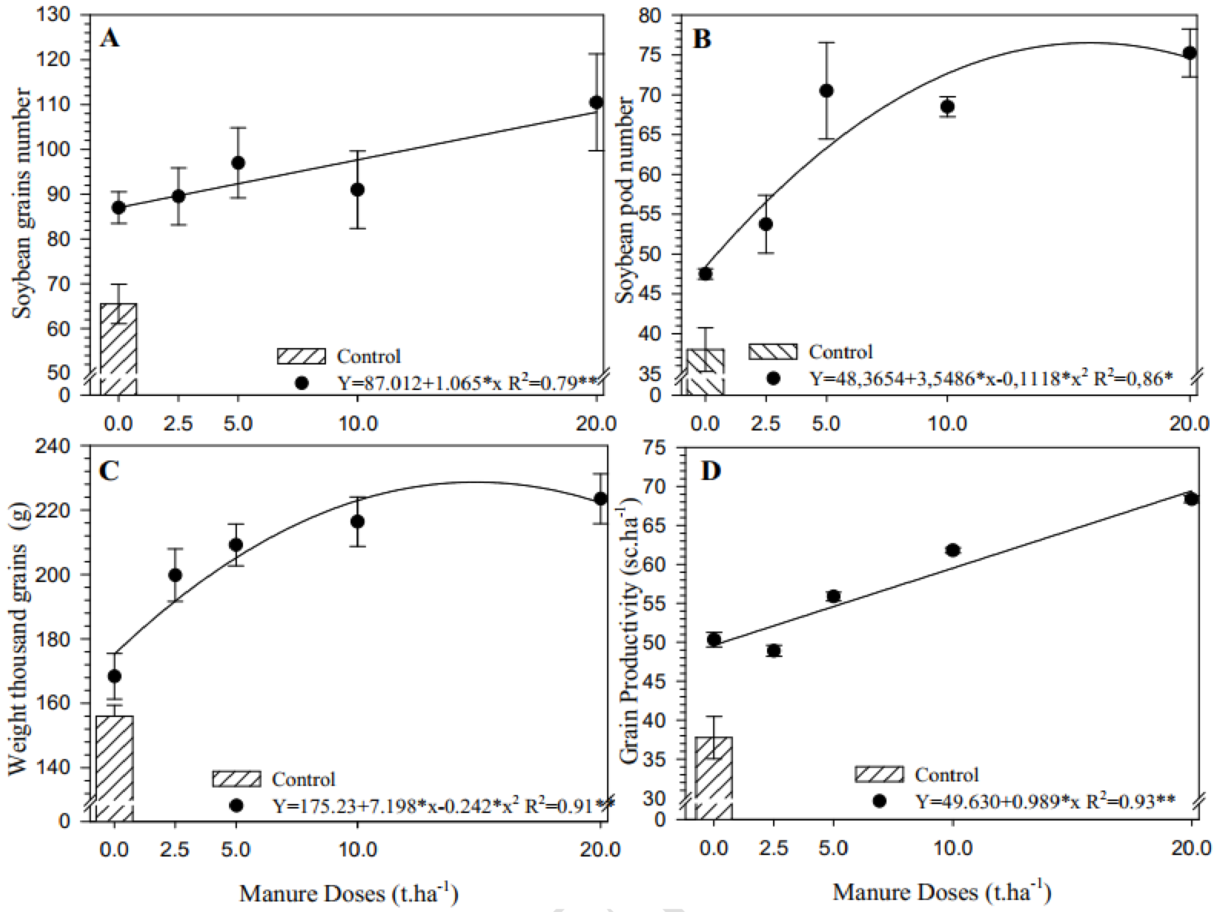

Fig. 3. Soybean grains number (A), soybean pod number (B), weight thousand grains (C) grains production (D) soybean cultivar 8579 RSF IPRO - IPRO BONUS, subjected to cattle manure doses Gurupi-TO.

Data presented in Fig (3) indicated that the soybean pod number characteristics (SP) and weight thousand grains (GW) the response occurred quadratically, the maximum efficiency point for SP was at the dose of 15.87 t ha^{-1} with 76.52 pods giving an increase of 101.38% about the control treatment 38 pods, and 61.10% about the dose 0.0 t ha^{-1} of cattle manure 47.5 pods. For GW, the maximum efficiency was at the dose of 14.87 t ha^{-1} with 228.75 g, making a difference of 46.64% about the 156 g control, and 35.84% about the dose of 0.0 t ha^{-1} with 168.84 g.

The results of the characteristics analyzed individually were plotted in a *Biplot plot* (Fig 4). According to [17], the minimum percentage of 80% of the total variance should be addressed to determine the appropriate number of components. Thus, two main components were selected for the study, which together explain 81% of the total variance. To better explore the results and demonstrate a joint view of all variables about manure doses, multivariate analysis was used in the PCA main component method, where it was observed that the dose 20.0 $t.ha^{-1}$ is the dose that represents the best results.

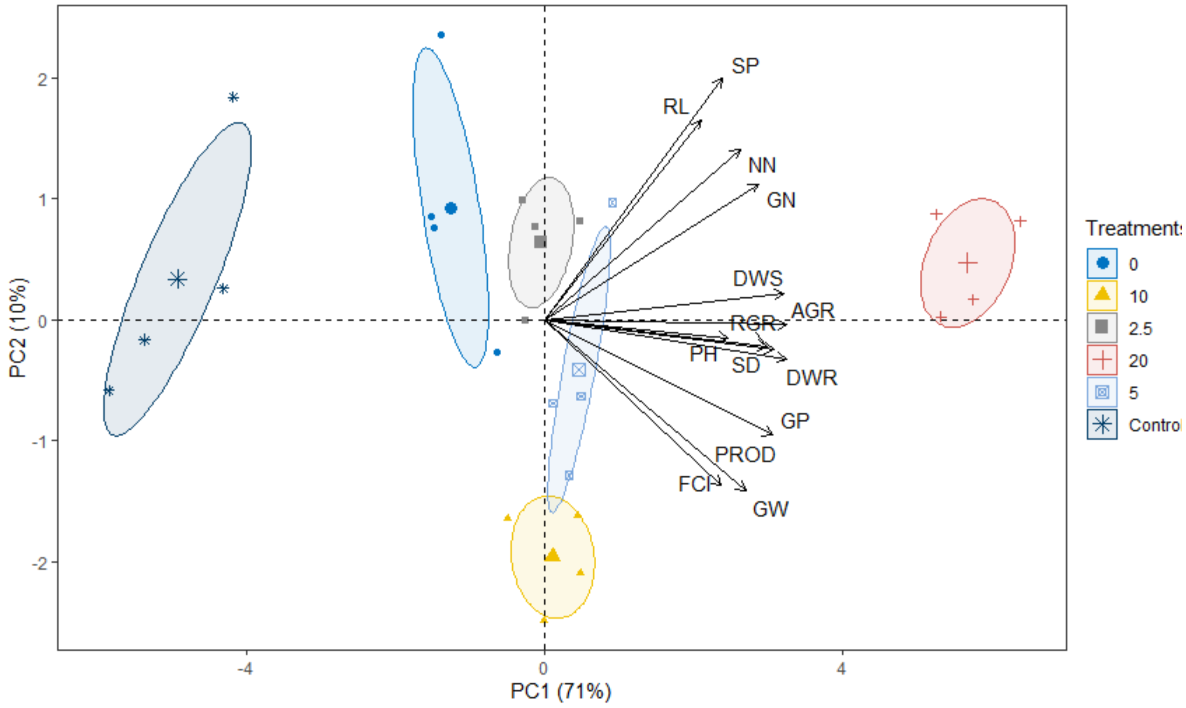

Fig. 4. Biplot PC1 x PC2 on the variable's response of soybean crop to the use of cattle manure obtained by PCA. Gurupi-TO.

The treatments show a difference in the control when presenting behavior in dissimilarity between the doses of cattle manure and the variables analyzed. The dose of 20.0 t ha^{-1} presented the highest Euclidean distance, being positive on the x and y-axis for PC1 and PC2, respectively, besides presenting behavior opposite the control treatments, Control and 0.0 t ha^{-1}, which makes it the ideal dose for crop cultivation according to the results of the research.

Going deeper into the response caused by fertilization, we demonstrated the answers in the abstract of leaf analysis of soybean crops under different doses of cattle manure and their respective mean values for N, P, K, Ca, Mg, Fe, and Zn are shown in Table 4. It is observed that the doses of cattle manure had significant responses in almost all chemical characteristics evaluated, except for the Ca and Mg content which presented no significant effect.

The responses in the leaf analysis of soybean crop show that the nutrients P, K, and Fe occurred linearly, with a difference of 27.5, 116, and 59.3% in the dose of 20.0 t ha-^{1} when compared with 0.0 t ha^{-1}, respectively (Table 4). For N and Zn, it was quadratic, with a maximum point of 15.65 and 13.94 t ha^{-1}, with an increase of up to 13.8 and 48.68 % in the contents of the respective nutrients observed when compared with the dose of 0.0 t ha^{-1}. Ca^{2+} and Mg^{2+} nutrients obtained a non-significant quadratic response.

Table 4. Summary of leaf analysis at the end of soybean cultivation, regression equation, and coefficient of determination (R^2), referring to N, P, K, Ca, Mg, Fe and Zn content as a function of cattle manure fertilization (0.0; 2.5; 5.0; 10.0 and 20.0 $t.ha^{-1}$) and negative control (Control), without the use of manure and mineral fertilizer. Gurupi - TO.

Variables	Manure Doses ($t.ha^{-1}$)						Average	CV%	Equations	R^2
	Control	0.0	2.5	5.0	10.0	20.0				
N (dag kg^{-1})	3.93	4.11	4.30	4.51	4.58	4.68	4.35	1.85	$Y=4.14+0.072*x-0.0023*x^2$	0.96**
P (dag kg^{-1})	0.48	1.38	1.47	1.54	1.55	1.76	1.36	7.07	$Y=1.410+0.0174*x$	0.94**
K (dag kg^{-1})	0.18	0.25	0.29	0.31	0.36	0.54	0.32	13.2	$Y=0.2387+0.0146*x$	0.97**
Ca^{2+} (dag kg^{-1})	0.29	0.33	0.34	0.38	0.36	0.33	0.34	7.49	$Y=0.34+0.006*x-0.0004*x^2$	0.71ns
Mg^{2+} (dag kg^{-1})	0.79	0.62	0.68	0.67	0.64	0.80	0.67	8.14	$Y=0.62^{**}+0.011*x-0.0005*x^2$	0.73ns
Fe (mg kg^{-1})	152.9	159.9	168.0	192.3	252.2	254.7	196.7	20.17	$Y=166.62+5.18*x$	0.81**
Zn (mg kg^{-1})	69.59	66.49	89.08	93.82	95.44	98.86	85.5	8.71	$Y=72.17+4.46*x-0.16*x^2$	0.82**

CV% = Coefficient of variation; **: significant at 1% ($p < 0.01$); *: significant at 5% ($0.01 \leq p < 0.05$); ns: not significant ($p \geq 0.05$) by the F test.

The reference foliar nutritional contents for P, K, and Fe in soybean crops are 0.25 dag kg^{-1}, 1.70 dag $kg^{-1,}$ and 50 mg kg^{-1}, where nutrients P and Fe presented levels well above the reference values independent of the treatment used while K had a response 68.23% lower than the reference value of the crop [9]. For nutrients N and Zn, the reference values are 4.50 dag kg^{-1} and 20 mg kg^{-1}, where N reached this value at the dose of 4.45 t ha^{-1}, and for Zn, the leaf responses were higher than the reference value, and at the dose 0.0 t ha^{-1} the content was 232% above.

Table 5 presents the abstract of soil analysis at the end of soybean crop cultivation under different doses of cattle manure and their respective mean values for Ca, Mg, Al, H+Al, pH, M.O, P, K, Fe, Zn, and Mn. It is observed that the doses of cattle manure had a great influence on almost all chemical characteristics evaluated, except only for the pH and Mn content which had a non-significant effect.

Table 5. Summary of soil analysis at the end of soybean cultivation, regression equation, and coefficient of determination (R^2), referring to Ca, Mg, Al, H + Al content, pH, MO, P, K, Fe, Zn, and Mn, due to the fertilization with cattle manure (0.0, 2.5, 5.0, 10.0 and 20.0 t.ha^{-1}) and negative control (Test), without the use of manure and mineral fertilizer. Gurupi - TO.

Variables	Manure Doses (t.ha^{-1})						Average	CV%	Equations	R^2
	Control	0.0	2.5	5.0	10.0	20.0				
Al^{3+} (cmolc dm^{-3})	0.14	0.13	0.15	0.12	0.11	0.09	0.13	9.33	Y=0.144*-0.0026*x	0.78**
H+Al (cmolc dm^{-3})	2.21	1.84	2.08	2.02	2.25	1.49	1.98	7.49	Y=1.84+0.086*x-0.005*x^2	0.93**
pH (H_2O)	5.88	5.53	5.41	5.29	5.58	5.68	5.56	3.73	Y=5.46-0.010*x+0.001*x^2	0.56^{ns}
M.O (g dm^{-3})	12.27	13.70	14.81	15.38	16.11	22.67	16.33	5.06	Y=1.42-0.001**x+0,003* x^2	0.98**
P (mg dm^{-3})	3.60	3.75	3.76	6.44	13.14	14.05	7.45	9.04	Y=3.86+0.582*x	0.84**
K (mg dm^{-3})	5.46	19.68	28.10	29.22	33.31	26.58	23.72	4.76	Y=20.84+2.30**x-0.10**x^2	0.93**
Ca^{2+} (cmolc dm^{-3})	1.94	2.19	2.28	2.74	2.82	3.37	2.56	4.76	Y=2.25+0.058*x	0.93**
Mg^{2+} (cmolc dm^{-3})	0.83	0.60	0.67	0.74	0.82	1.07	0.79	5.06	Y=0.61+0.022*x	0.99**
Fe (mg dm^{-3})	53.09	52.09	51.32	63.54	70.59	82.52	62.19	7.70	Y=51.96**+1.61*x	0.93**
Zn (mg dm^{-3})	1.44	10.31	11.39	13.14	13.75	13.10	10.52	8.84	Y=10.31+0.59**x-0.023*x^2	0.96**
Mn (mg dm^{-3})	15.89	23.52	24.30	25.44	25.18	24.75	23.18	5.55	Y=23.66+0.32*x-0.013*x^2	0.82^{ns}

CV% = Coefficient of variation; **: significant at 1% ($p < 0.01$); *: significant at 5% ($0.01 \leq p < 0.05$); ns: not significant ($p \geq 0.05$) by the F test.

M.O data after the crop cycle showed a significant increase in the linear form is a difference of 61.53 % between doses of 20.0 t ha^{-1} about the dose of 0.0 t ha^{-1}, with final content of 22.67 g dm^{-3} being a value considered average fertility where the values are 20.1 to 40.0 g dm^{-3} [9].

The availability, after the crop cycle, of nutrients P, Ca, Mg, and Fe occurred linearly, with differences of 212.2, 47.9, 71.2, and 52.5 % at the dose of 20.0 t ha^{-1} when compared with the dose of 0.0 t ha^{-1}, respectively. For K, Zn and Mn, it was quadratic, with a maximum point of 11.25, 14.08, and 12.30 t ha^{-1}, increasing 45.4, 172.8, and 357.5 % in the contents when compared with 0.0 t ha^{-1}.
The nutritional levels of P, K, Ca, Mg, Zn, Mn, and Fe considered for good fertility are 12.1 mg dm^{-3}, 71.0 mg dm^{-3}, 2.41 cmolc dm^{-3}, 0.91 cmolc dm^{-3}, 1.6 mg dm^{-3}, 9 mg dm^{-3}, 31 mg dm^{-3}, where nutrients P, Ca and Mg reached values considered ideal for good soil fertility at doses, 16.16, 14.73, 15.00 t ha^{-1}, and the nutrients Zn, Mn and Fe were considered high values regardless of the manure dose used and K with values considered average fertility [9].

4. DISCUSSION

Soybeans are one of the main crops commercialized in the country, and therefore an essential factor in the Brazilian economy. In this work, we investigated the accumulation of nutrients and productive changes of soybean cultivated as a function of the application of doses of cattle manure in pre-planting as a soil conditioner. The application of organic fertilizers allows the construction of soil fertility and makes possible greater efficiency of use and allows the plant to explore its full productive genetic potential [3]. Comparing doses and types of chemical and organic fertilizers observed that 5.0 t ha^{-1} cattle manure provided the largest increase in dry weight soybean plants, pods per plant, grains per pod, and grain production, but reduced the dry weight of root [18]. A result similar to that obtained in this study is the dose of 20 t ha^{-1}, the dose of best response for these characteristics. A survey shows that the addition of 80.0 t ha^{-1} cattle manure associated with dolomitic limestone in the soil significantly increases the yield of soybean grains grown in Red Latosol [19]. Manure associated with chemical fertilizers also helps maintain grain yield in soils affected by erosive processes [4]. Carvalho 2011 [20], found that the use of 3 t ha^{-1} organic residue enhanced the effect of mineral fertilizers on the height of soybean plants, obtaining positive linear values for this characteristic. These same authors justify this result by increasing organic radicals in the soil, which adsorption nutrients, reducing their leaching. Lima, 2009 [21] working with doses of manure in oilseeds obtained the best responses between doses of 4.0 e 5.0 t ha^{-1}. These authors attribute these results to the release of cations in the soil from the mineralization of manure, due to the buffering exercised in pH by the organic acids present, as a by-product of the decomposition and activity of microorganisms. These cations displace Al^{3+} from the surface of the clay, taking it to the soil solution, where it is quelatized by organic acids, becoming unavailable to plants. Also, adding organic waste to the soil was the negative loads of the soil increase, and with this, there is greater availability of nutrients to plants. In addition, agrosystems require soil conservation to be able to produce in the long term and on a large scale, for this the maintenance of organic matter in semiarid regions is one of the main factors for the development of sustainable production [22]. Silva; Raimundo; Forti, 2019 [23], applying 3.8 t ha^{-1} and cattle manure with a fertilizer formulated 8-20-15 growing soybean in the field under a Dystrophic Red Latosol, observed in the evaluated parameters a significant increase in plant height, number of nodules, dry matter mass of nodule, root length and dry matter mass of shoots when compared with the control and with the exclusive use of chemical fertilization. For grain productivity, there was a similar response to [24] that it was found that doses of organometal fertilizers provided a significant increase of 5% ($p<0.05$) better adjusting to the linear regression model, in which the highest yields were obtained at the maximum dose of 1.0 t ha^{-1} with the productivity of 3.6 t ha^{-1} with soybean CV BRS 283. About the number of pods, a response similar to that of [25], which obtained a quadratic response to the number of pods in legumes, with the highest production gain found above 25.0 t ha^{-1} cattle manure, for soybeans, it achieves the highest amount of pod production with less than 20.0 t ha^{-1}. Carvalho, 2011 [20] find a relationship with organic manure fertilization with weight thousand grains corroborating the data in Figure 2, showing that the addition of organic fertilization provides the best development of the plant reflected in its grain production, which makes cattle manure an option for soybean fertilization.

Thus, the analyzed characteristics of the soybean 8579 RSF IPRO – BÔNUS IPRO are positively influenced by the application of increasing doses of manure in Cerrado soil. This demonstrates the importance of further studies about the use of natural fertilizers because of their great potential to increase the mineral fertilization itself already used. Further studies conducted in the field with higher doses are necessary to elucidate issues such as the influence of manure on culture on biotic and abiotic stress, the main metabolic alterations of the plant, and the residual period of application. Generating a framework to better understand the interaction of manure in the soil-plant interface, contributes to the diffusion of the use of this practice as a way of management for producers in the region.

5. CONCLUSIONS

The cattle manure provided a positive increase in the increase of levels of Ca, Mg, M.O, P, K, Fe, Zn and in the characteristics of plant height, stem diameter, soybean node number, dry weight of shoot, Falker chlorophyll index, root length and dry weight of root. The dose of 20.0 t ha^{-1} was the best response dose for soil nutritional conditioning for both physical and chemical characteristics, being responsible for increasing the contents of these nutrients. For the agronomic characteristics of soybean grain number, soybean pod number, the weight of thousand grains, and grain productivity, fertilization with cattle manure in intercropping with conventional fertilization showed better results with 20.0 t ha^{-1} higher than other dosages. In general, when comparing the use of cattle manure in association with mineral fertilization, analyzing all characteristics, there is an average increase of 68.26% in a **comparison with mineral fertilizer only.**

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