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Yield and nutritional status of the conilon coffee tree in organic fertilizer systems[1]

Produtividade e estado nutricional do cafeeiro conilon em sistemas de adubação orgânica

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ABSTRACT - The conilon coffee tree presents high yield potential, the replacement of soil nutrients usually being by the use of mineral fertilizers. To reduce these fertilizers, the use of organic waste may be an alternative. The objective of this study was to evaluate the effect of organic fertilizer systems on the nutritional status and yield of the conilon coffee tree. On a farm, located in the town of Linhares, Espirito Santo, during the agricultural year of 2009/2010, a trial was set up using a completely randomized block design with a factorial distribution of 2 x 2 x 5 and three replications, the factors being: organic compost (compost 1 and compost 2); legumes (the presence and absence of jack beans, sown between the rows of coffee trees); and the proportions of each compost (0; 25; 50; 75 and 100%) as a substitute for the recommended mineral fertilizer. The increase in the proportion of compost 2 was reflected as increases in the P content of the leaves due to the higher concentration of this nutrient in the compost. The increase in compost input increased the S content of the leaves as a response to the increase in soil pH. Maximum values of 61 and 66 sacks ha-1 were obtained with substitutions (mineral source by organic) in the proportion of 40 and 37% for compost 1 and compost 2 respectively. The use of organic-waste composts is an alternative as a partial replacement of mineral fertilizers in the conilon coffee tree, resulting in increases in yield.

Key words: Nutrient uptake. Compost. Legumes. Family farmer.

RESUMO - O cafeeiro conilon apresenta alto potencial produtivo e a reposição dos nutrientes no solo é geralmente por meio de adubos minerais. Para reduzir esses adubos, o uso de resíduos orgânicos na propriedade agrícola pode ser uma alternativa. O objetivo do trabalho foi avaliar o efeito de sistemas de adubação orgânica sobre o estado nutricional e a produtividade do cafeeiro conilon. Em lavoura localizada no município de Linhares-ES, foi montado, no ano agrícola 2009/2010, experimento em blocos casualizados com distribuição fatorial de 2 x 2 x 5, com três repetições, sendo os fatores: composto orgânico (composto 1 e composto 2); leguminosa (presença e ausência do feijão-de-porco semeado nas entrelinhas dos cafeeiros); e, proporções de cada composto (0; 25; 50; 75 e 100%) em substituição à adubação mineral recomendada. O aumento das proporções do composto 2 refletiu em incrementos nos teores foliares de P devido à maior concentração desse nutriente nesse composto. O aumento do aporte de compostos incrementou os teores foliares de S em resposta ao acréscimo do pH do solo. Valores máximos de 61 e 66 sacas ha-1 foram obtidos com proporções de substituição (da fonte mineral por orgânica) de 40 e 37% para o composto 1 e composto 2, respectivamente. A utilização de compostos de resíduos orgânicos é uma alternativa para substituir parcialmente a adubação mineral no cafeeiro conilon com incrementos na produtividade.

Palavras-chave: Absorção de nutrientes. Composto. Leguminosa. Agricultor familiar.

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INTRODUCTION

Because of the high demand of the conilon coffee tree (*Coffea canephora* Pierre ex Froehner), the replacement of nutrients to the soil is usually done by means of mineral fertilizers of high solubility (PREZOTTI *et al*. 2007). However, due to international dependence on mineral fertilizers and their high cost, supplying the correct amounts can be an obstacle for rural farmers (SERRANO; SILVA; FORMENTINI, 2011). In the state of Espírito Santo, Brazil, the problem is compounded because the greater part of coffee production is concentrated in small family-based rural farms, which by their nature are badly financed.

An alternative in order to reduce mineral fertilizer is the use of organic sources on the farm. Theodoro; Mendes; Guimarães (2009), evaluated the effect of organic fertilizers on the yield of Arabica coffee and found that the use of castor meal resulted in higher productivity compared to cattle manure and poultry litter, with an average of 47 bags ha^{-1}. Moreover, management of organic fertilization can influence the dynamics of the nutritional status of the coffee plant. Serrano, Silva and Formentini (2011), studying foliar levels in conilon coffee when growing, found that an increase in the levels of organic compost produced a linear decrease in leaf Ca levels, and an increase in those of K.

Studying the nutritional status of the adult conilon coffee plant, Bragança, Prezotti and Lani (2007) determined appropriate limits for leaf macronutrient concentrations which can be used to support discussions related to the effect of fertilization managements, these being: 29 to 32 g kg^{-1} N; 1.2 to 1.6 g kg^{-1} P; 20 to 25 g kg^{-1} K; 10 to 15 g kg^{-1} Ca; 3.5 to 4 g kg^{-1} of Mg; and 2.0 to 2.5 g kg^{-1} S. Similarly, Partelli *et al*. (2006a) obtained the following averages for foliar levels in crops of adult conilon under both organic and conventional systems respectively: 27.6 and 26.4 g kg^{-1} N; 1.6 and 1.4 g kg^{-1} of P; 16.7 and 18.5 g kg^{-1} K; 13.5 and 11.6 g kg^{-1} Ca; 3.5 to 3.6 g kg^{-1} Mg; and 2.1 to 1.8 g kg^{-1} S.

Unlike that recorded for *Coffea canephora*, studies on the effect of organic fertilizer in *Coffea arabica* are found frequently in the literature (ARAÚJO *et al*., 2007; ARAÚJO *et al*., 2008; RANGEL *et al*., 2008; RICCI *et al*., 2005; THEODORO *et al*., 2003). Therefore, studies carried out on family farms are crucial to the development of strategies that incorporate organic residues into fertilizer, with a view to reducing the dependence of the conilon coffee plant on mineral fertilizers.

The objective of this work was to evaluate the effect of different organic fertilization managements on the nutritional status and productivity of the conilon coffee plant in the state of Espírito Santo, Brazil.

MATERIAL AND METHODS

The study was carried out on an irrigated crop of conilon coffee, on a family-based property located in the Córrego do Farias district of Linhares, Espitito Santo, Brazil (19°15’67’’ S and 40°01’93’’ W and a height of 17 m), from November, 2009 to June, 2011. According to the Köppen classification, the regional climate is of type Awi, characterized as hot and humid, with a rainy season in the summer and dry in the winter, having an average annual rainfall of 1,200 mm and an average temperature of 25 °C. The selected crop was of about 0.75 ha in size and four years old, grown at a spacing of 3.0 x 1.2 m and made up of 2 clones, 12 V - a component of the variety “Victory INCAPER 8142”, and G 35 from the Verdebras company.

The soil of the area is a dystrophic Red-Yellow Argisol, formed over sediments of the Barriers Formation (EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA, 2006). Before the study, a particle-size and chemical analysis of the area at a depth of 0 to 20 cm showed the following characteristics: sandy- loam in texture; pH (H_2O) 5.6; 1.9 dag kg^{-1} organic matter; 7 mg dm^{-3} P; 44 mg dm^{-3} K; 1.3 $cmol_c$ dm^{-3} Ca; $cmol_c$ 0.3 dm^{-3} Mg,; 0.1 $cmol_c$ dm^{-3} Al; 2.1 $cmol_c$ dm^{-3} H + Al; 1.7 $cmol_c$ dm^{-3} sum of bases (SB), 44.9% base saturation (V); 71 mg dm^{-3} Fe; 1.2 mg dm^{-3} Zn; 0.3 mg dm^{-3} Cu; 29 mg dm^{-3} Mn; and 0.16 mg dm^{-3} B (EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA, 1997).

Before implementation of the experiment, liming was carried out employing the base-saturation method, in order to bring it up to 70%. Foliar fertilization with micronutrients was performed in three applications: the first on 09/2010, the second on 10/2010 and the third on 11/2010 (PREZOTTI *et al*., 2007). For this, the commercial product Ubyfol - MS 77 (4.5% B, 0.1% Co, 2% Cu, 1% Fe, 1% Mn, 0.1% Mo and 13% Zn) was used.

The experiment was set up in a 2 x 2 x 5 factorial arrangement consisting of: organic compost (composts C1 and C2); legumes (presence and absence of); and proportions of each compost in five different amounts (0; 25; 50; 75 and 100%). A randomized-block design with three replications was used. Each replication was made up of a lot of 30 conilon coffee plants, with the 12 central plants being considered.

The composts used were: Compost 1 (C1), prepared by mixing elephant grass (*Pennisetum purpureum* Schumach) and coffee straw in the proportion of 1:1 (v: v), and Compost 2 (C2), prepared by mixing elephant grass, coffee straw and poultry litter in the proportion of 2:1:1 (v: v: v). Before building the windrows, grass at 180 days of regrowth, was removed from a grassy area and shredded to a size of 2 cm.

Setting up windrows of the compost was done on the same day as cutting the grass. C1 was set up by alternately stacking 50 cm high layers of vegetable residue. For C2, the layers were arranged with heights of 50 cm for the grass, 25 cm for the coffee straw and 25 cm for the poultry litter. Only one manual turning of the compost was carried out, 45 days after setting up the windrows. To guarantee uniform moistening, it was decided to irrigate once a week, always ensuring that the windrows received the same volume of water. On rainy days, plastic tarpaulins were used as cover.

After 120 days composting, using observed physical characteristics (mostly colour, temperature and particle size), the composts were found to be suitable for use. Samples were then chemically characterised at the Laboratory for Soil and Plant Analysis of INCAPER/ CRDR-CS (Table 1).

The legume used was the jack bean (*Canavalia ensiformis*), sown manually between rows in the 1st and 2nd agricultural years in November, 2009 and January, 2011 respectively. The spacing used when planting was of 1 m from the stem of the coffee plant and 50 cm between rows (giving three rows of legumes). Eight seeds were sown per linear meter of each rut. The plants were cut down at the flowering stage, 90 days after planting. After cutting, the hay was left whole and used as cover.

For the first and second crop years (2009/2010 and 2010/2011 respectively), treatment with added nutrients from mineral sources only (control or 0% organic matter) consisted in the application of 380 kg ha^{-1} yr^{-1} of N in the form of ammonium sulphate for an expected productivity of 51-70 bags ha^{-1} (PREZOTTI *et al*., 2007). For fertilization with phosphorus and potassium in the first year, 60 kg ha^{-1} yr^{-1} of P_2O_5 and 350 kg ha^{-1} yr^{-1} of K_20 were used, in the form of single superphosphate and potassium chloride respectively (PREZOTTI *et al*., 2007). In the second crop year, due to the residual effect of the fertilizer from the first year, phosphorus and potassium fertilization was carried out taking into consideration both that in the soil and the expected productivity (PREZOTTI *et al*., 2007).

The treatments with organic sources were determined from the N content of the organic composts, and from recommendations for mineral fertilization (PREZOTTI *et al*., 2007). For the first crop year, for the treatment with an exclusively organic source (100% organic compost), 25.33 Mg ha^{-1} yr^{-1} of C1 and 12.50 Mg ha^{-1} yr^{-1} of C2 (moist) were applied. For the second crop year, treatment consisted in the application of 42.44 Mg ha^{-1} yr^{-1} of C1 and 27.40 Mg ha^{-1} yr^{-1} of C2 (moist). In the first year the humidity of the composts was not taken into account when correcting the fertilization calculations. In the second year the 51% humidity of C1 and 39% humidity of C2 were taken into consideration.

Fertilizer was combined with the above-mentioned mineral sources in the proportions of 25; 50 and 75% of the amounts of organic compost. Therefore for 25; 50 and 75% organic compost, 75; 50 and 25% from mineral sources were used respectively. The fertilizers were applied to the canopy projection and around the entire plant.

In first crop year, fertilization was divided into four stages: 1st stage (20% of the fertilizer) in November, 2009; 2nd stage (20% of the fertilizer) in December, 2009; 3rd stage (20% of the fertilizer) in March, 2010; and 4th stage (40% of the fertilizer) in 2010/04. In the second year, fertilization was split into two stages: 1st stage (50% of the fertilizer) in January, 2011; and 2nd stage (50% of the fertilizer) in April, 2011.

Table 1 - Chemical characterisation (dried basis) of composts 1 (C1) and 2 (C2) from the 1st and 2nd crop years, at 120 days after setting up the windrows

[1]Type	[2]Humid.	[3]OM	C/N	[4]pH	N	P	K	Ca	Mg	S
	%	%			dag kg^{-1}					
1st crop year (2009/2010)										
C1	64.0	68.6	23	7.6	1.5	0.3	1.7	0.6	0.2	0.1
C2	59.5	62.8	10	7.1	3.0	3.5	3.1	3.6	0.7	0.4
2nd crop year (2010/2011)										
C1	50.9	49.4	14	7.2	1.8	2.2	2.1	1.0	0.1	0.2
C2	39.4	51.6	12	6.8	2.3	3.6	2.9	4.2	0.5	0.3

[1]Type: C1 (compost 1), prepared by mixing elephant grass (*Pennisetum purpureum*) and cofee straw in the proportion of 1:1 (v:v); C2 (compost 2), prepared by mixing elephant grass, coffee straw e poultry litter in the proportion of 2:1:1 (v:v:v); [2]Humid.: humidity of the organic composts; [3]OM.: organic matter; [4]pH em $CaCl_2$

In order to characterize the nutritional state of the plants, in September of 2010 leaves were collected from the middle third of the plants, at the third leaf pair counting from the apex of the horizontal branches on the four cardinal points of the plants and lots. Fifty leaves were collected from each lot and the material dried in a forced ventilation oven at 70 °C until reaching constant weight, and ground in a Wiley mill. The samples were then sent to the Laboratory for Soil and Leaf Analysis of INCAPER/CRDR-CS for quantification of the leaf macronutrient content, as per Malavolta, Vitti and Oliveira (1989).

In order to have a better interpretation and discussion of the leaf nutrient content, in August of 2010 the chemical attributes of the soil at a depth of 0-20 cm, were characterised. In each lot, with the help of a probe (SONDATERRA ®), single samples were taken from under the canopy of the 12 experimental plants in order to make up one composite sample. The samples were sent to the Laboratory for Soil Analysis of INCAPER/CRDR-NE for the quantification of pH and macronutrient values (EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA, 1997). The characterisation data are shown in Table 2.

Harvesting the fruits of the coffee plants was carried out in June, 2011. In order to determine productivity the total volume (in litres) produced per lot was quantified. A representative sample of 2 litres was taken from the total volume, and dried on a raised terrace to about 14% humidity. The samples were then peeled in an electric peeler and the humidity measured to reach 13% by mathematical equation. They were then weighed with precision scales and converted into values for productivity, as sacks produced per hectare (sacks ha^{-1}).

The data were subjected to preliminary tests to verify the normality and homogeneity of variance by means of the Lilliefors and Bartlett tests respectively. They were subsequently subjected to variance analysis ($p \leq 0.10$) using the SISVAR software. When significant, the Tukey test ($p \leq 0.10$) was used for the

Table 2 - Chemical characterisation of the soil at a depth of 0-20 cm, for all fertilization treatments of the conilon coffee plant

[1]Treatments	[2]pH	Al	Ca	Mg	P	K
		------cmol$_c$ dm^{-3}------			------mg dm^{-3}------	
MFJ	4.80	0.17	1.05	0.32	38.30	129.33
MF	4.87	0.25	1.26	0.34	34.80	126.67
F25C1J	5.17	0.08	1.48	0.40	29.77	198.00
F25C1	5.33	0.13	1.50	0.54	40.67	148.67
F50C1J	4.80	0.14	1.19	0.44	23.47	187.33
F50C1	5.00	0.13	1.29	0.46	26.77	174.33
F75C1J	5.23	0.07	1.84	0.59	26.97	261.00
F75C1	5.23	0.04	1.31	0.54	15.00	156.00
F100C1J	6.53	0.00	2.11	0.82	16.87	530.00
F100C1	6.50	0.00	1.60	0.65	11.77	346.33
F25C2J	4.70	0.18	1.01	0.34	54.47	197.00
F25C2	4.93	0.12	1.18	0.40	39.00	210.33
F50C2J	4.70	0.19	1.16	0.41	50.30	156.33
F50C2	5.00	0.06	1.41	0.46	41.87	118.67
F75C2J	4.97	0.12	1.59	0.57	49.37	226.33
F75C2	5.17	0.06	1.34	0.53	49.00	150.67
F100C2J	6.43	0.00	1.64	0.72	61.00	199.67
F100C2	6.27	0.00	1.72	0.64	59.20	258.33

[1]Meanings of the abreviations of the treatments: MFJ = mineral fertilizer with jack bean; MF = mineral fertilizer; F25C1J = Fertilizer with 25% of compost 1 e jack bean; F25C1 = Fertilizer with 25% of compost 1; F50C1J = Fertilizer with 50% of compost 1 e jack bean; F50C1 = Fertilizer with 50% of compost 1; F75C1J = Fertilizer with 75% of compost 1 e jack bean; F75C1 = Fertilizer with 75% of compost 1; F100C1J = Fertilizer with 100% of compost 1 e jack bean; F100C1 = Fertilizer with 100% of compost 1; F25C2J = Fertilizer with 25% of compost 2 e jack bean; F25C2 = Fertilizer with 25% of compost 2; F50C2J = Fertilizer with 50% of compost 2 e jack bean; F50C2 = Fertilizer with 50% of compost 2; F75C2J = Fertilizer with 75% of compost 2 e jack bean; F75C2 = Fertilizer with 75% of compost 2; F100C2J = Fertilizer with 100% of compost 2 e jack bean; F100C2 = Fertilizer with 100% of compost 2. [2]pH in water (ratio 1:2.5)

qualitative factors, and regression analysis ($p \leq 0.10$) for the quantitative factors. The models were chosen based on the significance of regression coefficients, using Student's t-test at a level of 10%.

RESULTS AND DISCUSSION

Table 3 shows the results of the variance analysis for those variables analysed. It was found that productivity (bags produced per hectare) adjusted to the quadratic model concomitant with the increase in proportion of the two organic composts (Figure 1). From this behaviour it can be inferred that partial substitution of the mineral fertilizer by the organic favoured productivity. Only the highest proportion of compost caused a reduction in productivity. It is known that the positive effects of organic materials added to the soil occur over time (MELO; SILVA; DIAS, 2008). Splitting fertilization and not releasing nutrients in the period of greatest need of the coffee plants (the final stage of grain formation and start of fruit maturation) may explain some of the lowest yields for the 100% substitution ratio. The heavy infestation of scale insects in those treatments with a greater addition of compost is another factor that may have led to reduced productivity (field observation).

According to the responses observed in Figure 1, it was possible to estimate the proportion of compost and mineral fertilizer suitable for obtaining maximum values for productivity. Maximum values of 61 and 66 bags ha^{-1} were obtained with substitution ratios (of the mineral source by the organic) of 40% and 37% for C1 and C2 respectively. These productivity values were close to the average (obtained by evaluating eight consecutive harvests) of 72 bags ha^{-1} for the conilon "Victory INCAPER" 8142 variety (FERRÃO *et al*., 2007), and more than 51 bags ha^{-1} obtained in the fourth harvest of plants propagated by cuttings and under organic fertilization (PARTELLI *et al*., 2006b).

Not correcting the humidity of the composts in fertilization calculations in the first crop year, resulted in a lower input of N with the increase in the proportions of the composts. Thus, carrying out organic fertilization based on the recommendations of N for mineral fertilization should be revised, since higher yields were obtained with reduced amounts of N compared to the control (mineral fertilizer) which received the recommended amount according to Prezotti *et al*. (2007). Organic molecules originating from decomposed and humified waste (humic substances, for example) may have physiological effects on the plant, allowing development independently of the supply of nutrients (NARDI *et al*., 2002).

For productivity and leaf macronutrient content, there were generally no pronounced effects of the legume ($p>0.10$), probably due to its high rate of decomposition associated with the application of the straw waste as soil cover, as well as the low concentration of nutrients in the plant (Table 3).

Regarding leaf N, K, P and S content, when compared to the leaf content of adult plants (BRAGANÇA; PREZZOTTI; LANI, 2007; PARTELLI *et al*., 2006a), the overall averages were within or above the sufficiency range recommended by these authors.

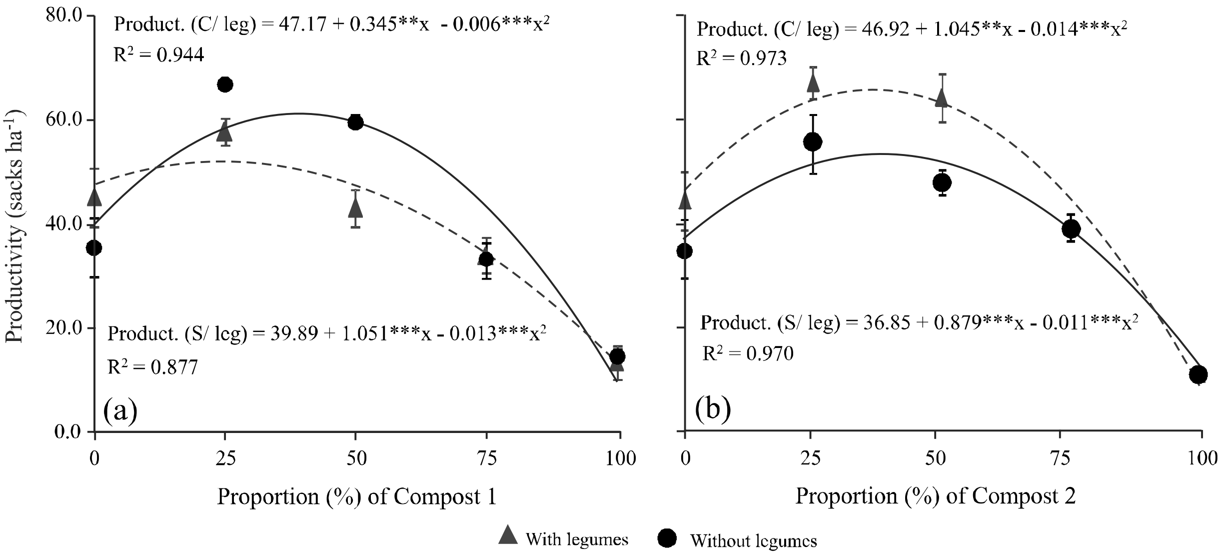
For leaf N and K content, there was no difference ($p>0.10$) among the treatments, whereas foliar P levels

Table 3 - Mean squares and coefficients of variation (CV) for productivity values and leaf macronutrient levels as a function of the amounts or proportions (0; 25; 50; 75 and 100%) of organic compost, both in the presence and absence of legumes (jack bean)

Sources of variation	GL	Mean Squares						
		[1]Prod.	N	P	K	Ca	Mg	S
Block	2	96.93*	11.32^{ns}	0.20**	34.54*	3.95**	0.08^{ns}	0.28**
Compost	1	47.44^{ns}	0.02^{ns}	0.11ns	19.72^{ns}	0.50^{ns}	0.00^{ns}	0.10^{ns}
Legume	1	70.35^{ns}	2.82^{ns}	0.22*	17.28^{ns}	5.10**	0.34**	0.03^{ns}
Dosage	4	4294.67***	13.31^{ns}	0.57***	24.73*	4.32***	0.08^{ns}	0.54**
Compost/legume	1	459.65***	46.82**	0.09^{ns}	26.14^{ns}	0.00^{ns}	0.04^{ns}	0.00^{ns}
Compost/dosage	4	46.89^{ns}	0.56^{ns}	0.11^{ns}	19.90^{ns}	0.26^{ns}	0.11^{ns}	0.06^{ns}
Legume/dosage	4	52.16^{ns}	7.02^{ns}	0.08^{ns}	6.00^{ns}	1.70^{ns}	0.15*	0.02^{ns}
Compost/legume/dosage	4	173.75***	4.27^{ns}	0.04^{ns}	9.25^{ns}	1.06^{ns}	0.04^{ns}	0.01^{ns}
CV%		15.06	7.82	12.43	11.68	10.53	11.13	10.66

[1]Prod.: productivity; ***; **; *: significant at 1; 5 and 10%, respectively; and ^{ns} not significant by the F-test

Figure 1 - Mean productivity values (sacks ha^{-1}) as a function of the proportions (%) of compost 1 (a) and compost 2 (b) in the presence and absence of legumes (jack bean). DMS (Tukey at 10%) for studying the factor legume at the proportions of the composts: 8.5023. Vertical bars: standard error. ***, **, *: Significant at 1, 5 and 10% respectively, by Student's t-test



increased linearly with the increase of C1 in the absence of legumes, and of C2 in both the presence and absence of legumes (Figure 2). The higher concentration of P in C2 (Table 1) accounts for increases in the levels of this nutrient as the proportions of the organic fertilizer are increased. On the other hand, the higher amount of organic carbon (organic matter) supplied by C1 at the time of fertilization possibly determined the increase in foliar P levels. Organic input may reduce the maximum adsorption capacity of P and the binding energy of the phosphate to the inorganic colloids in the soil, making the P more readily available to the plants (ANDRADE *et al*., 2003; GUAÇONI; MENDONÇA, 2003; PARTELLI *et al*., 2006a; RHEINHEIMER; ANGHINONI; CONTE, 2003).

As for the foliar S levels, there was a fit to the quadratic model with the increase in proportions of C1 in the presence of legumes, and linear increases with the increase in proportions of C2 (Figure 3). Input of the composts tended to reduce soil acidity (Table 2) with

Figure 2 - Average leaf phosphorus (P) content as a function of the proportions (%) of compost 1 (a) and compost 2 (b) in the presence and absence of legumes (jack bean). DMS (Tukey at 10%) for studying the factor legume at the proportions of the composts: 0.337. Vertical bars: standard error. ***, **, *: Significant at 1; 5 and 10%, respectively by Student's t-test

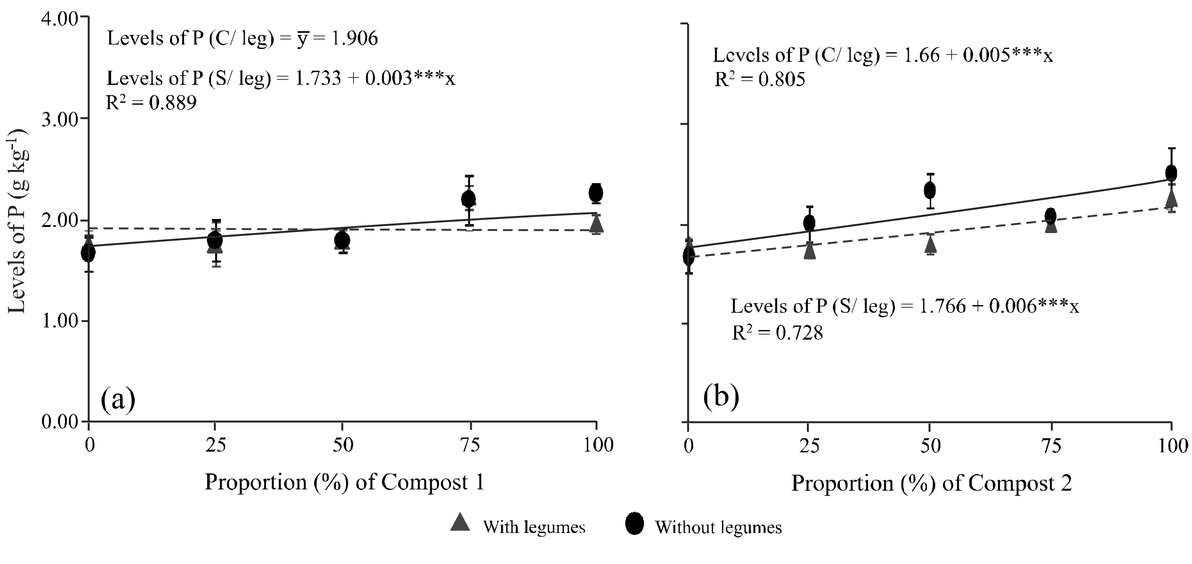
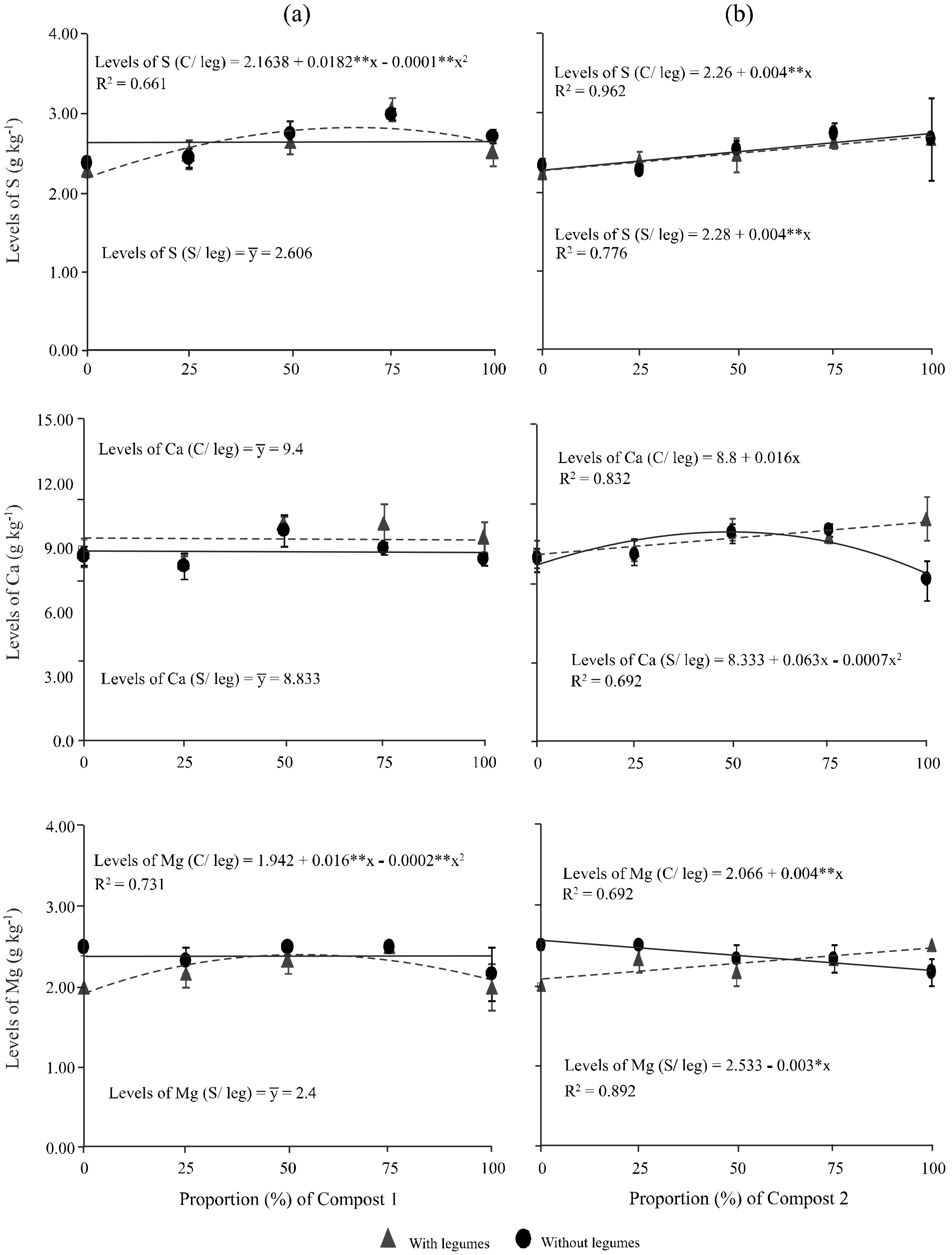


Figure 3 - Average leaf content of sulphur (S), calcium (Ca) and magnesium (Mg) as a function of the proportion (%) of compost 1 (a) and compost 2 (b) in the presence and absence of legumes (jack bean). DMS (Tukey at 10%) for studying the factor legume at the proportions of the composts: S - 0.3719; Ca - 1.3353; and Mg - 0.3537. Vertical bars: standard error. ***, **, *: Significant at 1; 5 and 10% respectively by Student's t-test



a probable increase in the availability of SO_4^{2-} through desorption of the minerals in the clay and/or favouring mineralisation, as observed by Nogueira and Melo (2003). Silva *et al*. (1999) found higher concentrations of SO_4^{2-} due to liming of the soils, a Low Humic Gley and a Red-Yellow Latosoll, which may mean a greater availability of S for the plants.

In spite of the effects observed for Ca and Mg in response to the proportions of the composts used (Figure 3), leaf content for these elements were below those recommended by Partelli *et al.* (2006a) and Bragança, Prezotti and Lani (2007). After N, Ca is the nutrient most accumulated by the conilon coffee plant (BRAGANÇA; PREZOTTI; LANI, 2007), being essential for cell wall stability and the processes which control the permeability of the plasma membrane (TAIZ; ZEIGER, 2004). Mg is the fourth most-accumulated macronutrient by the conilon (BRAGANÇA; PREZOTTI; LANI, 2007) and, due to its occupying the centre of the chlorophyll molecule, plays a fundamental role in photosynthesis (TAIZ; ZEIGER, 2004).

CONCLUSIONS

1. The greatest input of organic compost provides higher foliar P content, due to the reduction in P adsorption and the improvement in the physical and biological properties of the soil;
2. The increase in the amount of compost enhances foliar S levels in response to the increase in soil pH;
3. Under conditions similar to this study, for yields of around 61 to 66 bags ha^{-1}, the proportion recommended for replacement of the mineral source by the organic is 37 to 40%;
4. Organic fertilization of the coffee plant based on the recommendation of mineral N to achieve a given output should be reviewed, since with a lesser input of N, higher yields are obtained, which emphasises the role of organic matter as a promoter of plant growth, besides promoting improvements in the chemical, physical and biological properties of the soil;
5. The use of composts from organic waste is an alternative to partly replace mineral fertilizer in the conilon coffee plant, with increases in productivity.

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