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Cientific Paper

Effect of grazing and residual of nitrogen fertilization in winter pasture on bean yield in an integration crop-livestock system in South-Central region of Paraná, Brazil

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Abstract

The experiment was carried out in 2008/2009 under field conditions in the Campus Cedeteg of UNICENTRO in Guarapuava, Paraná, to evaluating the effect of grazing by lamb and nitrogen fertilization in winter and summer season on bean crop. The experimental design was in randomized blocks with sub subplots with three replications. The main plot was composed of nitrogen doses (0, 75, 150 and 225 kg ha^{-1}) in black oat and ryegrass pasture during winter season; the subplots were composed of grazing by lambs; and the sub subplots were nitrogen doses (0, 60, 120, 180 and 240 kg ha^{-1}) in summer season in the bean crop. The grazing did not show effect on bean yield. The winter nitrogen fertilization singly did not affect the yield components, whereas the plant height, number of branches, number of pods and thousand grains mass had quadratic response due to summer nitrogen fertilization. There was interaction between nitrogen fertilization in winter and summer on number of nodes per plant and bean yield. Therefore, residual effect of nitrogen applied on pasture was verified on bean crop, which indicates this strategy could be adopted by farmers as a way of maximizing the forage and animal production in winter season and it would also benefit the bean crop in succession.

Key words: *Phaseolus vulgaris* L.; nitrogen, grain yield.

Efeito do pastejo e residual da adubação nitrogenada na pastagem sobre a produtividade da cultura do feijão em um sistema de integração lavoura-pecuária na região Centro-Sul do Paraná, Brazil

Resumo

Com o objetivo de avaliar o efeito do pastejo de ovinos e da adubação nitrogenada de inverno e de verão sobre a cultura do feijão, um experimento foi desenvolvido em condições de campo em Guarapuava, PR, na safra 2008/2009. O delineamento foi de blocos casualizados com parcelas subsubdivididas em três repetições. A parcela principal consistiu das doses de N (0, 75, 150 e 225 kg ha^{-1}) no período de inverno na pastagem de aveia preta e azevém comum, as subparcelas foram compostas pela presença ou ausência do pastejo de ovinos, e as subsubparcelas, por sua vez, pelas doses de N no verão na cultura do feijão (0, 60, 120, 180 e 240 kg ha^{-1}). O pastejo não apresentou efeito sobre a produtividade de feijão. A adubação de inverno isoladamente não afetou os componentes da produtividade, ao passo que, a altura de planta, número de ramos, número de vagens e massa de mil grãos apresentaram resposta quadrática devido à adubação nitrogenada de verão. Houve interação entre a adubação nitrogenada de inverno e verão sobre a produtividade de feijão e número de nós por planta. A partir dessa interação, foi verificado efeito residual do N aplicado na pastagem durante o período de inverno sobre a cultura do feijão no período de verão, indicando que esta seria uma estratégia que poderia ser adotada pelos produtores de forma a maximizar a produção de forragem e produção animal no inverno e, que ainda beneficiaria a cultura do feijão em sucessão.

Palavras-chave: *Phaseolus vulgaris* L., nitrogênio, rendimento de grãos.

Efecto del pastoreo y del nitrógeno residual del abono en los pastos sobre la productividad del cultivo de frijol en un sistema de integración cultivo-ganadería en la región Centro Sur de Paraná, Brasil

Resumen

Con el fin de evaluar el efecto del pastoreo de ovejas y la fertilización nitrogenada de invierno y verano en el cultivo de frijol, se realizó un experimento en condiciones de campo en Guarapuava-PR, en 2008/2009. El diseño fue de bloques al

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azar con un diseño de parcelas divididas con tres repeticiones. La parcela principal consistió en dosis de N (0, 75, 150 y 225 kg ha^{-1}) durante el invierno en la avena y aceven común (RayGrass), las parcelas secundarias fueron compuestos por la presencia o ausencia de pastoreo de ovejas, y la división (parcelas terciarias) a su vez, por los niveles de N en verano en el cultivo de frijol (0, 60, 120, 180 y 240 kg ha^{-1}). El pastoreo no tuvo efecto en el rendimiento del frijol. El aporte solo de abono en el invierno no afectó los componentes del rendimiento, mientras que, altura de planta, número de ramas, número de vainas y peso de mil granos mostró una respuesta cuadrática debido a la fertilización nitrogenada de verano. Hubo interacción entre la fertilización nitrogenada en invierno y de verano sobre la productividad y el número de nudos por planta. A partir de esta interacción se observó efecto residual de N aplicado en el pasto durante el invierno en el cultivo de frijol en el período de verano, lo que indica que se trata de una estrategia que podría ser adoptada por los productores para maximizar la producción de forraje y la producción animal en el invierno, y que todavía beneficiaría el cultivo de frijol en la sucesión.

Palabras clave: *Phaseolus vulgaris* L.; nitrógeno; rendimiento de grano.

Introduction

In the southern region of Brazil, in virtue of the high economic risk of the winter cereal cultivation, many agricultural areas are left in fallow or cultivated with cover plants. In this context, the system of integration crop-livestock has been gaining prominence as a way of better using these areas with the generation of additional income. Furthermore, several authors have demonstrated that the introduction of the animal in the production systems, since it has the adequate management, can cause improvement in the soil fertility by the accumulation of organic matter, alteration in the cycling of nutrients (LANG, 2004; FLORES et al., 2008), improvement in the efficiency of fertilizers use and of the differentiated capacity of nutrients absorption (LUSTOSA, 1998; CARVALHO et al., 2010).

According to ASSMANN et al. (2004), the favorable conditions of weather and soil, which are dominant in the southern of Brazil, benefit the dry matter production of the forage species of cold seasons, thus allowing the obtaining of high yields of forage production during the winter. The first basic condition that must be recognized and respected is that there will only be animal production in pastures if these are kept stable and productive (SILVA, 2005). Thus, it is important to consider that the growth of forage plants and, consequently its production, depend of factors related to the plant and to the soil and climatic conditions. The availability of nutrients in the soil has great importance in the growth and production of forages (ASSMANN et al., 2004), and from these, the nitrogen is the one that exerts most influence.

Among the cultivated crops in the summer period, the bean plant (*Phaseolus vulgaris* L.) presents great importance in the Central-south region of the Paraná state, being a demanding plant in nutrients, due mainly of its reduced and not very deep root system, besides of its short cycle, being of 90 to 100 days (ROSOLEM and MARUBAYASHI, 1994). For being the most absorbed nutrient and the most exported by the plants, the N must be made available in quantity and in the adequate season for maximization of the productive potential of the crop (SILVA et al., 2000).

The main sources of N for the bean crop are the soil, through the decomposition of organic matter, the application of nitrogen fertilizers and the biological fixation of atmospheric N_2 through symbiosis with bacteria, however the efficiency of biological fixation of nitrogen in bean and is not so efficient, being necessary the adoption of other sources to supply the demand of the bean plant (BRITO et al., 2011).

In this context, the adequate management of nitrogen fertilizer represents one of the main difficulties of the bean crop, since the application of excessive doses of N, besides of increasing the production cost, can promote serious risks to the environment, and its use in insufficient quantity can limit its productive potential, even if other production factors are optimized.

In systems of crop-livestock integration, it has been related residual effect of the nitrogen fertilizer in the winter pasture on the crop in succession (SANDINI et al., 2011). This could be a strategy that would allow increment in the forage production and animal production and, at the same time, benefit the crop in succession, and perhaps may lead to reduction in the fertilizers quantity applied in the bean crop.

Having in sight that the studies with the bean crop are limited, the objective of the study was to assess the lambs grazing effect and of the increasing doses of nitrogen applied in the winter pasture and increasing nitrogen doses applied in the bean crop in the summer, on the bean crop yield in a system of crop-livestock integration in the Central-South region of the Paraná state.

Material and Methods

The experiment was developed in the *Campus* Cedeteg of the Universidade Estadual do Centro-Oeste (UNICENTRO), in the municipality of Guarapuava, PR. The experimental area is located at 1.025 m of altitude in the geographical coordinates 25° 33′ 36″ S and 51° 27′ 39″ W. The weather of the region, by the Köppen classification, is classified as Cfb, being humid mesothermal subtropical, without dry season, with annual average temperature of 17 °C and annual average rainfall of 1.960 mm (IAPAR, 2013).

The experimental area soil is classified as Latossolo Bruno Distroférrico típico and presented the following chemical characteristics at the depth of 0 to 20 cm: pH $CaCl_2$ 0.01M: 4.7; P: 1.1 mg dm^{-3}; K^+: 0.2 $cmol_c$ dm^{-3}; organic matter: 26.2 g kg^{-1}; Al^{3+}: 0.0 $cmol_c$ dm^{-3}, $H^+ + Al^{3+}$: 5.2 $cmol_c$ dm^{-3}; Ca^{2+}: 5.0 $cmol_c$ dm^{-3}; Mg^{2+}: 5.0 $cmol_c$ dm^{-3} and saturation of basis: 67.3%.

Since 2006 the experimental area has been conducted in a crop-livestock integration system. The data of this study refer to the results obtained during the season 2008/2009. The total area of the experiment corresponded to 3.5 hectares, being divided in 15 pickets (plots) with an area of 0.2 ha each. In each plot was isolated an area of 96 m^2 which remained without being grazed. The remaining 0.5 ha was used for the management of regulator animals.

It was used an experimental design of randomized blocks with subdivided plots and three repetitions. The main plot consisted of N doses in the winter pasture (0, 75, 150 and 225 kg ha^{-1}), the subplots corresponded to the grazing (presence and absence) and the subplots consisted of N doses in summer in the bean crop (0, 60, 120, 180 and 240 kg ha^{-1}).

The sowing of black oat (*Avena strigosa* Schreb.) and ryegrass (*Lollium mutiflorum*) was made at 04/15/08, in a no tillage system in succession to maize crop. Before the sowing was performed the desiccation of the weeds with glyphosate herbicide. The sowing operation was made with seed drills of continuous flux, spacing between lines of 0.17 m, sowing depth of 3 cm and density of 60 and 20 kg ha^{-1} of oat and ryegrass seeds, respectively.

The fertilization of basis was performed at the moment of sowing with 50 kg ha^{-1} of P_2O_5 (triple superphosphate) and 50 kg ha^{-1} of K_2O (potassium chloride). The nitrogen fertilizer, in function of the treatments, was made with urea (45% N) in a single application at the beginning of the tillering. In 06/10/08 the grazing started, which lasted until 11/22/08, totalizing 162 days. The used animals were lambs of the Ile de France breed, which remained with their mothers until the 07/28/08, when they were weaned. The method of grazing was of continuous stocking, with variable stocking rate, being the pasture kept with a height of 14 cm.

The quantity of dry mass of the grazing residue was estimated 15 days after the removal of animals. The production of dry mass (DM) was determined in the animals removal through the cut of forage in two representative areas of 0.25 m^2. The samples collected in field were dried in greenhouse with forced air circulation in a temperature of 60 °C for 72 hours and the obtained dry mass was converted to kg ha^{-1}.

After the removal of the animals and 15 days before the bean sowing was performed desiccation of weeds. It was used seeds of black bean (*Phaseolus vulgaris*) of the IPR-Graúna variety. Before the sowing, the seeds were preventively treated with fungicides with tolylfluanid basis (500 g L^{-1}) and carbendazin (500 g L^{-1}) and with insecticide with imidacloprid basis (700 g L^{-1}), respectively, in the doses of 120, 50 and 200 g more 200 mL of water for each 100 kg of seeds. The bean sowing was made using the system of direct sowing in 12/15/08. The sowing density was calculated with basis in the crop value of the seed, in a way to obtain the final population of 250.000 plants ha^{-1}, being the spacing between lines of 0.40 m. The basis fertilization in the bean was made distributing the fertilizer on the soil surface before the sowing. The used amount of fertilizer was of 50 kg ha^{-1} of P_2O_5 and K_2O through the commercial formula 00-20-20, while the nitrogen fertilizer with urea (45% of N) in agreement with the established treatments was performed in the stage V_3.

The experimental unity presented dimension of 3.2 x 6 m, however, only the two central rows of the plot with discharge of 0.5 m of each edge of the sowing row were used for evaluation of the yield and its components.

The final population of plants per hectare was obtained by counting of the number of plants in the plot useful area before the harvest. The grains yield, in kg ha^{-1} was obtained by conversion of the obtained yield in 4 m^2 with moisture of 13%. The height of plants and of insertion of the first pod was obtained by evaluation of the three plants in the physiological maturation stage. It were used 20 plants for evaluation of the number of branches, number of nodes on the main stem and from this sum was achieved the number of nodes per plant. The percentage of fertile nodes was assessed considering the number of nodes with productive branches in relation to the total number of nodes in the plant. It was counted the total number of grains and pods in the plant, thus obtaining the number of grains per pod. From a sample of 300 grains was assessed the mass of a thousand grains, thus achieving the value in grams,

For the statistical analysis, the data in percentage was transformed to √x+1. All data was submitted to variance analysis through the statistical program Sisvar and the averages compared through the Tukey test at 5% of probability for the qualitative factor (grazing) and through polynomial regression for the quantitative factor (doses of nitrogen in the winter and summer). It was tested linear and quadratic models and the choice was based in the significance (smaller or equal to 5%).

Results and Discussion

The dry masses of the oat and ryegrass grazing residue were superior in the areas without grazing in relation to the grazed areas and presented, in both cases, quadratic responses with the increase of the N dose applied during the winter (Figure 1), agreeing with the data obtained by SANDINI et al. (2011). These results were already expected, once the vegetal biomass is consumed by animals in grazing, and consequently, their values are inferior in relation to the areas without grazing. Furthermore, several studies already mentioned that with the increase of the N dose there is increment in the forage production (ASSMANN et al., 2004; PELEGRINI, 2008).

The maximum dry mass of residue in the areas without grazing was of 6.786 kg ha^{-1} and in the areas with grazing of 2.459 kg ha^{-1} with application of 166 and 121 kg ha^{-1} of N, respectively, which represents increment in the grazing residue of 23% and 18% in relation to the non fertilized areas. These results of residue quantity of dry mass are inferior to the related by SANDINI et al. (2011) who obtained up to 12.133 kg ha^{-1} and 2.790 kg ha^{-1} in the areas without and with grazing, respectively. Regarding the percentage increments, the areas without grazing had similar values to those related by SANDINI et al. (2011) with increment of 25%; however, in the areas with grazing the values were inferior in relation to the increments

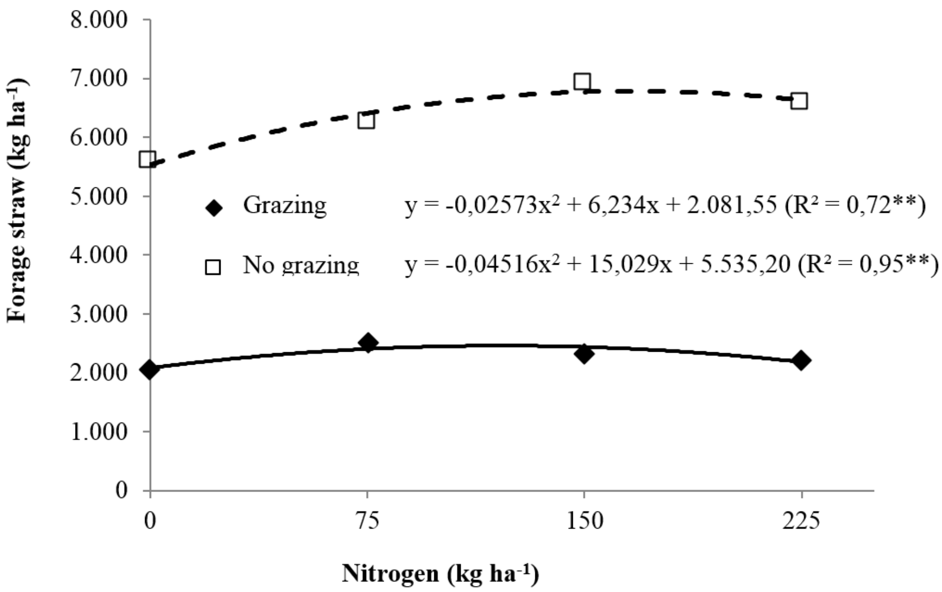

Figure 1. Dry mass (kg ha^{-1}) of forage straw, with and without grazing by lambs, and nitrogen doses in the pasture during winter season. Guarapuava, PR, 2013.

of 100% and 86% mentioned by SANDINI et al. (2011) and ASSMANN et al. (2003).

The grazing did not affect the yield, number of branches, number of pods and mass of a thousand grains of bean (Table 1), agreeing with the results achieved by BALBINOT JUNIOR et al. (2009) with the bean crop, and by SANDINI et al. (2011) and ASSMANN et al. (2003) with maize crop. In the areas which were graze was verified reduction in the height of bean plants, height of insertion of the first pod and number of nodes per plant, on the other hand, there was higher percentage of fertile nodes and number of grains per pod, thus causing no effect on the crop yield (Table 1 and 2).

Table 1. Variation factors, freedom degrees (FD), mean squares and F calculated (Fc) values to grain yield (kg ha^{-1}), plant height (cm), first pod insertion height (cm), number of branches per plant, number of nodes per plant, fertile nodes per plant (%), number of pods per plant, number of grains per pod and thousand grain mass of beans. Guarapuava, PR, 2013.

Variation factor	FD	Mean squares (Fc)		
		Grain yield	**Plant height**	**First pod insertion height**
Blocks	2	634775,32 (0.01)**	42.25 (0.34)ns	2.89 (0.61)ns
Grazing (G)	1	124207,08 (0.29)ns	799.77 (0.00)**	55.72 (0.00)**
Winter treatments (WT)	3	210101,67 (0.14)ns	42.35 (0.35)ns	6.17 (0.37)ns
Summer treatments (ST)	4	2460299,05 (0.00)**	620.80 (0.00)**	12.96 (0.07)ns
G x WT	3	32457,78 (0.83)ns	7.12 (0.91)ns	5.05 (0.46)ns
G x ST	4	74162,18 (0.61)ns	46.63 (0.31)ns	4.66 (0.52)ns
WT x ST	12	221875,72 (0.03)*	54.79 (0.17)ns	8.41 (0.16)ns
G x WT x ST	12	44107,14 (0,96)ns	36.16 (0.50)ns	7.36 (0.24)ns
Error	78	110088.81	38.12	5.74
Average		3748	53.21	11.27
Variation coeficient (%)		8.85	11.60	21.26
		Branches per Plant	**Nodes per plant**	**Fertile nodes per plant (%) (1)**
Blocks	2	0.2652 (0.32)ns	49.9715 (0.01)**	0.0858 (0.44) ns
Grazing (G)	1	0.0791 (0.56)ns	119.0118 (0.00)**	1.1666 (0.00)**
Winter treatments (WT)	3	0.2328 (0.39)ns	8.5705 (0.46)ns	0.1599 (0.21) ns
Summer treatments (ST)	4	1.5976 (0.00)**	256.7251 (0.00)**	0.3182 (0.02)*
G x WT	3	0.0583 0.86)ns	10.1533 (0.39)ns	0.1289 (0.30) ns
G x ST	4	0.2879 (0.30)ns	16.8423 (0.16)ns	0.0604 (0.68) ns
WT x ST	12	0.2379 (0.43)ns	20.5387 (0.03)**	0.1630 (0.12) ns
G x WT x ST	12	0.2878 (0.27)ns	10.9866 (0.36)ns	0.1158 (0.36) ns
Error	78	0.2305	99.146	0.1041
Average		2.46	26.62	6.44
Variation coeficient (%)		19.5	11.83	5.01
		Pods per Plant	**Grains per pod**	**Thousand grains mass**
Blocks	2	25.3847 (0.01)**	0.1232 (0.70)ns	258.3009 (0.18)ns
Grazing (G)	1	2.0083 (0.51)ns	1.6381 (0.03)*	0.6893 (0.95)ns
Winter treatments (WT)	3	5.8473 (0.28)ns	0.3783 (0.36)ns	246.6233 (0.18)ns
Summer treatments (ST)	4	83.6449 (0.00)**	0.3334 (0.43)ns	761.3613 (0.00)**
G x WT	3	2.2735 (0.68)ns	0.3659 (0.37)ns	78.5069 (0.66)ns
G x ST	4	10.5543 (0.06)ns	0.3914 (0.35)ns	209.4441 (0.23)ns
WT x ST	12	6.7489 (0.14)ns	0.3944 (0.34)ns	141.9523 (0.48)ns
G x WT x ST	12	4.1940 (0.52)ns	0.4016 (0.33)ns	144.7972 (0.46)ns
Error	78	44.929	0.3472	1,457.259
Average		15.27	4.92	248.10
Variation coeficient (%)		13.88	11.99	4.87

*ns No significant; * Significant at 5% and ** at 1% of probability by F Test.*

Table 2. Effect of grazing on characteristics evaluated in the experiment with bean crop. Guarapuava, PR, 2013.

Characteristics	Grazing				
	Yes		No		Average
Grain yield (kg ha^{-1})	3781	A	3717	A	3749
Plant height (cm)	55.80	A	50.63	B	53.21
First node inserion height (cm)	11.95	A	10.59	B	11.27
Number of branches per plant	2.49	A	2.44	A	2.46
Number of nodes per plant	27.61	A	25.62	B	26.62
Fertile nodes per plant (%)	39.37	B	41.88	A	40.62
Number of pods per plant	15.40	A	15.14	A	15.27
Number of grains per pod	4.80	B	5.03	A	4.92
Thousand grain mass (g)	248.17	A	248.02	A	248.10

Averages followed by same letter in the same row do not differ from each other at 5% of probability by Tukey Test.

BALBINOT JUNIOR et al. (2009) called the attention to a very important factor and which applies for the results obtained in this study as well. The authors observed that there was no significant comparison as consequence of animal grazing, and therefore, was not identified negative effect on the bean crop in succession. This is all due to the adequate management of the grazing, as performed in this study, considering the offer of forage to determine the stocking rate, thus avoiding the super or subgrazing.

There was no interaction of the grazing with the nitrogen fertilization of winter and summer (Table 1), corroborating with the results obtained by BALBINOT JUNIOR et al, (2009) with the bean crop and being contrary to the results obtained by SANDINI et al. (2011) with the maize crop.

The nitrogen fertilization in winter did not presented effect on any of the assessed variables, whereas the fertilization in the summer influenced all variables, excepting the insertion of the first pod height and number of grains per pod (Table 1). The plant height, number of branches, number of pods and mass of a thousand grains presented quadratic response with the increase of the nitrogen dose in summer (Figure 2). With basis in the obtained regression equations, it can be verified that the higher height of plant of 57.2 cm would be obtained with application of 163 kg ha^{-1} of N (Figure 2A), while the greater number of branches per plant of 2.65 would be obtained with application of 170 kg ha^{-1} of N (Figure 2B). The doses of 168 kg ha^{-1} and of 232 kg ha^{-1} of N provided the greatest number of 16.8 pods per plant and 253 g in the mass of a thousand grains, respectively (Figure 2C and 2D). Soon, it was verified that there was increment in 26%, 29%, 37% and 5.7% in the plant height, number of branches per plant, pods per plant and mass of a thousand grains in relation to absence of nitrogen fertilization in the summer.

According to SANDINI (2009), the N used in the grazing and in the bean crop elevated the plants height, but not the height of insertion of the first pod, contributing to increase the plant lodging of the same, although problems with plant lodging were not verified in this study. STONE and MOREIRA (2001) verified that the number of pods per plant, mass of 100 grains and bean plant yield responded significantly to the increasing doses of N, applied at 35 days after the emergence (DAE). SORATTO et al. (2006) verified linear increase in the number of pods per plant, grains per pod, mass of 100 grains of bean irrigated with the increase of the N dose in cover at 15 or 30 DAE.

There was significant interaction of the nitrogen fertilization of winter and of summer on the yield and number of nodes per plant (Table 1). Without nitrogen fertilization in winter and summer the bean yield was 3.018 kg ha^{-1}, being incremented in 11%, 26%, 34% and 37% with addition of 60, 120, 180 and 240 kg ha^{-1} of N in summer, respectively (Figure 3A). Moreover, was verified that with the increase of the N dose in winter occurred linear response on the bean yield in the absence of nitrogen fertilization of summer, while with 60, 120 and 240 kg ha^{-1} of N in summer the response was quadratic to the increase of N, and not had significance in the dose of 180 kg ha^{-1} in winter, indicating residual effect of the fertilization performed in the winter season. The maximum yield of 3.635, 3.767 and 3.883 kg ha^{-1} of the doses of 60, 120 and 240 kg ha^{-1} of N in summer would be

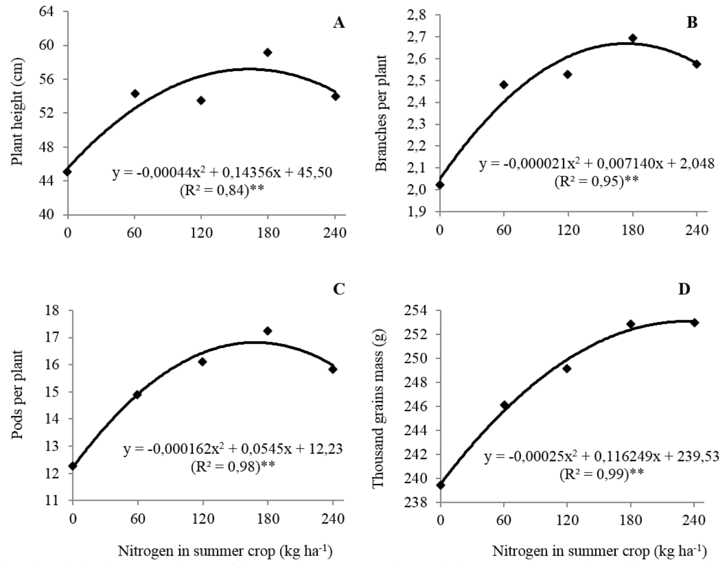

Figure 2. Plant height (cm) (A), number of branches per plant (B), number of pods per plant (C) and thousand grain mass (D) of beans with increasing of nitrogen dose in summer crop in an integration crop-livestock system. Guarapuava, PR, 2013.

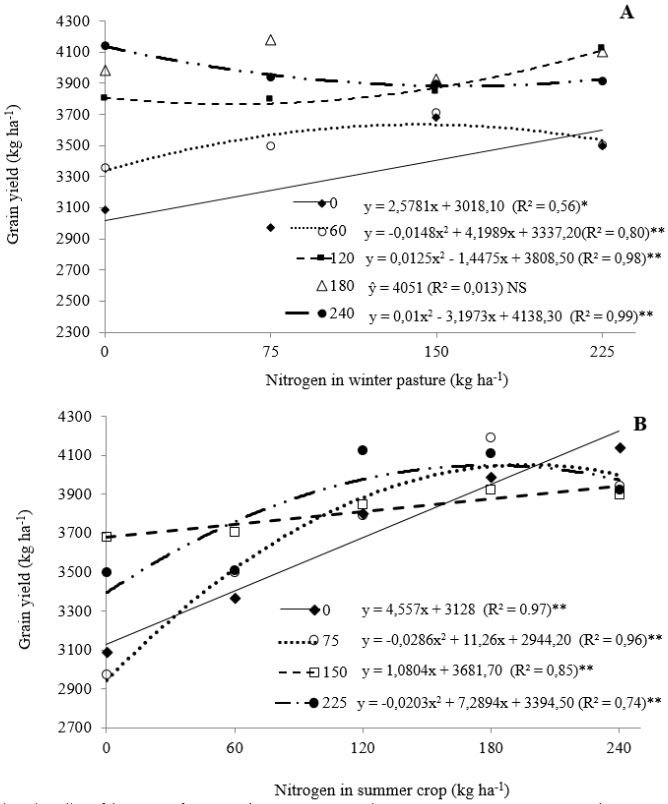

Figure 3. Grain yield (kg ha^{-1}) of beans for each nitrogen dose in summer crop due to nitrogen doses applied in winter pasture (A); and nitrogen doses in winter pasture according to nitrogen doses in summer crop (B). Guarapuava, PR, 2013. **Significant at 1% of probability.

obtained with application of 142, 58 and 160 kg ha-1 de N in the winter. SANDINI et al. (2011) also found residual effect of winter fertilization. These results can be related with the greater recycling of nutrients promoted by the presence of the animal in the system. STONE and MOREIRA (2001) obtained the maximum bean yield with application of 137 kg ha-1 of N in cover, being very similar to the value of 140 kg ha-1 of N obtained by SORATTO et al. (2006) in the first year of bean cultivation, with linear response in the second year, and inferior to 185 kg ha-1 mentioned by FARINELLI et al. (2006).

In the absence of winter nitrogen fertilization and with the application of 150 kg ha-1 of N the bean yield presented linear response with the increase of the N dose in summer, while the doses of 75 and 225 kg ha-1 of N in winter the response was quadratic (Figure 3B). With basis in the regression equations, the maximum yield of 4.052 e 4.049 kg ha-1 for the doses of 75 and 225 kg ha-1 of N in winter would be obtained with the application of 197 and 180 kg ha-1 of N in summer.

The unique component of yield which presented interaction between nitrogen fertilization of winter and summer was the number of nodes per plant. There was linear behavior with increase of the N dose in winter when was not performed the fertilization of N in summer, while the response was quadratic for the increasing doses of N in the summer (Figure 4A). However, the number of nodes per plant presents quadratic response for all the doses of N in winter in function of the increase of the N dose in the summer (Figure 4B).

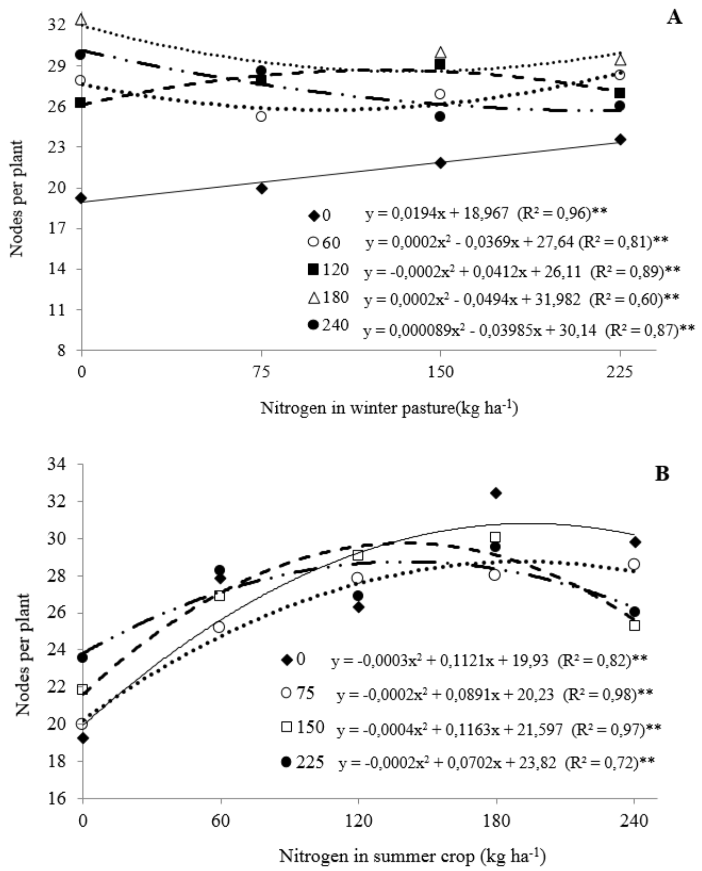

Figure 4. Number of nodes per plant of beans for each nitrogen dose in summer crop due to nitrogen doses applied in winter pasture (A); and nitrogen doses in winter pasture according to nitrogen doses in summer crop (B). Guarapuava, PR, 2013. **Significant at 1% of probability.

Conclusions

The bean yield is not affected with the presence of the animal in grazing in the area before its cultivation, being positive the use of the crop-livestock integration system.

There was effect of the winter nitrogen fertilization on the bean crop yield, however, was not sufficient to maximize it, evidencing the need of complementation. The quantity of nitrogen to be used in the bean must be defined in function of the nitrogen quantity applied in the winter.

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