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Productivity of lettuce culture in the function of nitrogen fertilizer management

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Abstract: The objective of this work was to evaluate the lettuce yield under the different management of nitrogen fertilization. The ammonium sulfate $(NH4)_2 SO_4$ with 950 kg ha^{-1} was used as a source of nitrogen. The treatments were constituted: 100% of the N incorporated in the base; 100% of N in single application coverage; 50% of the N incorporated in the base and 50% in cover parceled in 2 times; 25% of the N incorporated in the base and 75% in coverage, divided in 3 times; 100% of N in 3-fold parcel coverage and the control (without N application). The plants were harvested 42 days after transplanting and analyzed the variables weight of the fresh aerial part, aerial dry mass, the number of leaves and height of plant and stem diameter. It was verified that, for all evaluated characteristics, the response to nitrogen application was positive. It was concluded that the treatments 2, 3, 4 and 5 did not difference significantly from each other, and there was no decrease in productivity, the control verified the nitrogen requirement for this crop being below the averages in all variables analyzed.
Keywords: *Lactuca sativa*; fertility; vegetables.

Introduction

In Brazil, horticulture has presented high productive potential during the last years (Carvalho et al., 2013). Besides being of great importance in consumption for human consumption, it must contain vitamins, minerals, and fibers, essences for human life (MAPA, 2010).

With more and more vegetables on the consumers' table, among them the most commonly consumed are squash, lettuce, potatoes, sweet potatoes, onions, carrots, peppers, cabbage and tomatoes.

Lactuca sativa is an annual plant belonging to the family Asteraceae, originating in regions the temperate climate and has a great nutritional requirement (Henz and Suinaga, 2009). It presents different cultivars and the most consumed in Brazil are the crisp and smooth lettuces.

Its consumption is considered as one of the main vegetables, both for taste and for its nutritional value, affordable price (Resende, 2007), low calories, rich in fiber and widely used in diets (Filgueira 2009 adapted from Araujo, 2011). Resende (2007) points out that with the launching of new lettuce cultivars and management systems, irrigation, spacing, crop dealings, crop techniques, post-harvest conservation and mineral nutrition (Faquin and Andrade, 2004; Bandeira et al., 2011) have made lettuce the hardest consumed in the country.

Nitrogen (N) is one of the elements most demanded by plants, being overcome in some species only by potassium (K) (Faquin and Andrade, 2004). Nitrogen is considered to be very important because it is responsible for the morphological changes in plants and amines, amino acids, nucleic acids, proteins, coenzymes, nucleotides, coenzymes, chlorophylls and secondary metabolites that are present in the plant defenses (Taiz; Zeiger, 2013). In leafy vegetables, N is responsible for productivity, when applied to the crop, causes leaf area expansion, improves appearance and presents a higher photosynthetic rate (Filgueira, 2003). N deficiency slows down plant growth (Almeida et al., 2011), leading to poor head formation and yellowing of older leaves and commercialization (Goto et al., 2001; Melo Silva, et al., 2010).

The requirement for nutrients varies according to species and varieties and growth stage with different levels of need (Beninni et al., 2005). Ammonium sulfate is a nitrogen fertilizer that presents a low tendency of volatile N losses and low nitrification rate, besides being an economical source of sulfur (24% S). These characteristics provide agronomic advantages, often leading to high yields and improved agricultural product quality (Cruz, 2007).

According to Oliveira et al. (2014) studying the application of nitrogen and water in the soil for lettuce cultivation, observed that more and more important studies regarding the production systems to optimize the productive efficiency of the plant and are being more studied.

In view of the need for further studies on nitrogen fertilization in lettuce cultivation, research should be carried out with the aim of presenting protocols that aid in crop cultivation. Thus, the objective of this work was to evaluate the lettuce yield under the different management of nitrogen fertilization.

Methods

The experiment was conduced out in a greenhouse between May and June 2016, at the State University of Maringá, Umuarama-Pr, located at 23°45'53'' S and 53°19'30'' O; Altituce 442 m and typical dystrophic Red Latosol (Embrapa, 2013).

The experimental design was a randomized block, with six treatments and five replications, totaling 30 experimental units. Ammonium sulfate $(NH4)_2$ $SO)_4$ was used as the nitrogen source, being 952 kg ha^{-1} (200 kg of N ha^{-1}), which resulted in 0.86 g SA-vessel. It was used pots polyethylene with 1.8 kg of typical dystrophic Red Latosol soil were used as culture vessel (Table 1). The correction was carried out to raise the saturation of bases (V%) to 80%, applying 5 t ha^{-1} of limestone dolomite (PRNT 75%), totalizing 4.5 g pot^{-1}. Based on the soil analysis, 200 kg ha^{-1} of K_2O in the form of KCl and 200 kg ha^{-1} of P_2O_5 in the form of triple super phosphate were also used, both applied in the base and incorporated.

Table 1. Chemical characterization atributes and soil clay content used in the experiment, analyzes in the 0-20 cm layer of a typical dystrophic Red Latosol under natural field, Umuarama – Pr.

pH (H_2O)	Ca	Mg	Al	P	K	S	H+Al	T	V	M.O.	Argila
1 : 2,5	----- $cmol_c$ dm^{-3} -----			- mg dm^{-3} -		------ $cmol_c$ dm^{-3} ---			%	----g kg^{-1}----	
4,9	0,66	0,23	1,3	5,5	27	0,96	4,96	5,9	16,22	15	200

Ca, Mg, Al = (KCl 1 mol L^{-1}); P, K=(HCl 0.05 mol L^{-1} + H2 SO4 0.025 mol L^{-1}); S=sum of bases; H + Al=potential acidity (Calcium acetate); T=CTC; pH= 7.0; V=Base Saturation; M.O.=organic matter (Walkley-Black).

The experiment consisted in evaluating the different forms of nitrogen application (N) in lettuce culture and their respective productivity. The treatments were: T1- 100% of the N incorporated in the base, at the moment of the transplant of the seedlings; T2- 100% of the N in the cover applied at the moment of the transplant of the seedling; T3- 50% of the incorporated N in the base and 50% in cover parceled in 2 times with 15 days of interval between the applications; T4- 25% of the N incorporated in the base and 75% in coverage, divided in 3 times with 10 days application interval; T5- 100% of the N in the non-incorporated base, divided in 3 times with 10 days of application interval between the fertilizations and T6- Witness, without application of N.

To establish the treatments, lettuce seedlings cultivated Milena were used 10 days after emergence (DAE). Samples were harvested and taken to the laboratory for determination of the number of Leaves (NF) (determined by counting the number of total leaves present in each plant), plant height (AP) (using a graduated ruler, measuring the plant from the soil surface to the upper end) determined by weighing the aerial part of the lettuce with an analytical balance) and then taken to a greenhouse with forced air circulation at 60ºC for 24h to obtain the dry mass of the shoot (MSPA) and the diameter of the stem (DC) (measured with a caliper).

The mean values of the studied variables were submitted to analyses of variance by the F test and comparison of means by the Tukey test, both at 5% probability. All statistical analyzes were performed using ASSISTAT Software Version 7.7.

Results and discussion

Regarding the results for fresh shoot mass (MFPA), stem diameter (DC), plant height (AP), dry shoot mass (MSPA) and number of leaves (NF) at 42 days after planting until (Without N application), differed from the other treatments in all analyzed variables, presenting a lower mean (Table 2).

The results obtained with the experiment indicated significant differences between treatments fertilized with N only in three variables (MFPA, DC, and MSPA). For MFPA, treatment 3 (50% of the N incorporated in the base and 50% in the 2-fold parcel coverage) was the one that presented the highest average differing significantly from the treatments 1 and the control. Comparing the variables, the control treatment (without application of N) presented a lower average in relation to the other treatments, thus indicating the need of nitrogen for this crop. With 100% (T1) applied and incorporated in the planting, it was a lower result, but similar when compared to (T2), where 50% of the N recommendation was applied to the plantation and the other half applied in coverage 2 times.

Table 2. Fresh shoot mass (MFPA), stem diameter (DC), plant height (AP), dry shoot mass (MSPA) and number of leaves (NF) evaluated at 42 days after planting the crop, Umuarama – PR.

TREATMENTS	MFPA (g)	DC (cm)	AP (cm)	MSPA (g)	NF
1	49,74 b	1,16 a	13,20 a	6,13 a	16,20 a
2	55,82 ab	0,97 b	13,70 a	5,16 a	15,80 a
3	64,24 a	1,04 ab	14,22 a	6,44 a	17,80 a
4	58,34 ab	1,00 ab	14,16 a	6,80 a	16,60 a
5	54,45 ab	0,90 b	13,48 a	5,62 a	16,80 a
6	11,57 c	0,35 c	07,14 b	1,48 b	09,20 b
F_{cal}	36,75*	53,34*	91,47*	16,41*	25,69*
CV (%)	14,26	9,64	5,04	20,40	8,91

T1 = 100% of the N incorporated in the base; T2 = 100% of N applied in single application coverage; T3 = 50% of the N incorporated in the base and 50% in cover parceled in 2 times; T4 = 25% of the N incorporated in the base and 75% in coverage, divided in 3 times; T5 = 100% of N in 3-fold installment coverage; T6 = Witness, without application of N. * Averages in the same column followed by the same lowercase letter, for the mentioned evaluation periods, do not differ by Tukey's mean test (p≤0.05). = = Significant. NS = not significant.

For the variable MFPA (Figure 1), treatment 3 (50% of the N incorporated in the base and 50% in the 2-fold parcel coverage) presented a higher mean, but only statistically differing from treatment 1 (100% Base) and the control. Ferreira (2002), also achieved higher yields of MFPA at the same dose and similar N splits in the lettuce crop and also found that doses above 200 kg of N ha^{-1} showed a decrease in yield of this variable.

Application of incorporated nitrogen and/or undercoat presented little interference in lettuce crop productivity, dose splitting also did not significantly interfere with final yield. The quality of the culture was not affected by the treatments tested (Resende et al., 2012).

In relation to stem diameter (Fig. 2), the lettuce culture presented the highest mean in treatment 1 (100% of the N incorporated in the base), differing from treatment 2 (75% of the N incorporated in the base and 25% in the coverage). Treatment 5 (100% of the N in the non-incorporated base) and control. Oliveira et al. (2012) reported that there was an increase in stem diameter according to increasing doses of nitrogen (doses between 0 and 200 kg ha^{-1}) in the lettuce crop.

Application of incorporated nitrogen and/or undercoat presented little interference in lettuce crop productivity, dose splitting also did not significantly interfere with final yield. The quality of the culture was not affected by the treatments tested. For Bernardi et al. (2005) the external appearance of the vegetables is of great importance since the consumer always looks for the most attractive ones. The nitrogen available in the ideal quantity for the plants promotes vegetative growth, under these conditions the plant accumulates large proportions of water which explains the low proportion of dry matter, this explains why in this experiment the dry mass of the aerial part (Figure 3) did not show results between treatments that had N.

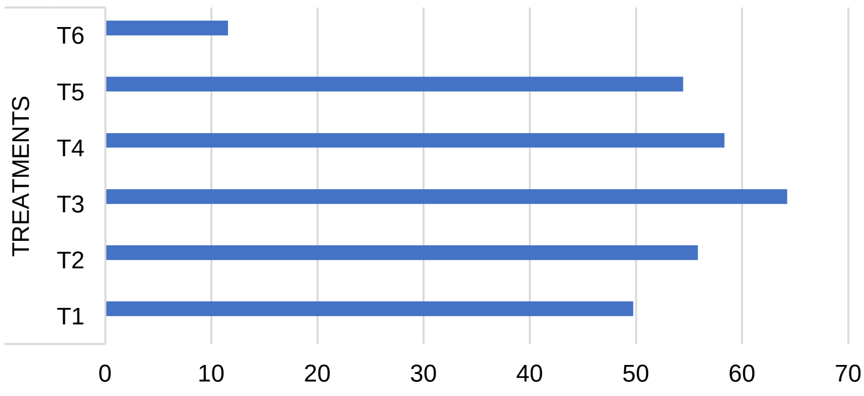

Figure 1. Fresh aerial mass (MFPA) g plant^{-1} lettuce cultivar Milena

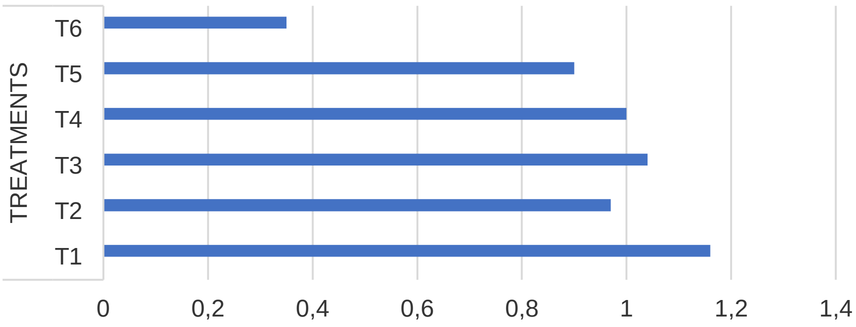

Figure 2. Stem diameter of lettuce plants cultivar Milena (cm)

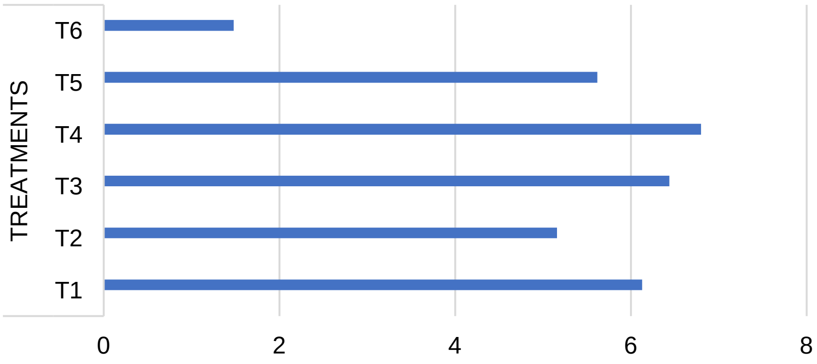

Figure 3. Aerial dry mass (MSPA) g plant-1 lettuce cultivar Milena

Beninni, Takahashi, and Neves (2005) observed that the accumulation of nutrients is directly related to the accumulation of dry matter in lettuce plants, both hydroponic and conventional. Similar results were obtained by Terra et al. (2001), in lettuce grown in the conventional system.

The control (treatment 6) presented a lower mean in relation to the other treatments (treatments with N were not statistically different from each other) for the variables plant height, dry shoot mass and leaf number. This result was possibly due to the lack of nitrogen in the control. For Coelho Fernades (1973), nitrogen is the nutrient that develops faster effects on the development of plants, being the main component of proteins and regulates the absorption of phosphorus, potassium and other nutrients by plants, being of extreme importance for the Plant to express its maximum productivity.

According to Almeida et al. (2011) observed that N deficiency significantly impaired plant growth, causing a decrease in plant height, leaf area, number of leaves, indirect chlorophyll content and dry mass of lettuce plants.

Conclusion

It is concluded that 100% N treatments applied in single application coverage; 50% of the N incorporated in the base and 50% in cover parceled in 2 times; 25% of the N incorporated in the base and 75% in coverage, divided in 3 times; 100% of the N in 3-fold parcel coverage did not significantly influence all the analyzed variables, thus not altering crop productivity.

It is not indicated the total application of the ammonium sulfate incorporated, because it increases the leaching in the form of nitrate (NO^{-3}) of the same, making less available for the culture.

Nitrogen availability is a limiting factor since the control without N applied showed the lowest averages in all analyzed variables.

References

ALMEIDA TBF; PRADO RM; CORREIA MAR; PUGA AP; BARBOSA JC. Avaliação nutricional da alface cultivada em soluções nutritivas suprimidas de macronutrientes. **Biotemas**, n.24, p. 27-36. 2011.

ARAUJO, W, F. et al. Resposta da alface a adubação nitrogenada. **Agro@ambiente**, v. 5, n. 5, p.12-17, 2011.

BANDEIRA, G.R.L.; PINTO, H.C.S.; MAGALHÃES, P.S.; ARAGÃO, C.A.; QUEIROZ, S.O.P.; SOUZA, E.R.; SEIDO, S.L. Manejo de irrigação para cultivo de alface em ambiente protegido. **Horticultura Brasileira**, Brasília, v.29, n.2, p. 237-241, 2011.

BENINNI, E. R. Y.; HIDEAKI, W.T.; NEVES, J.V.; SILVIA, C. Concentração e acúmulo de macronutrientes em alface cultivada em sistemas hidropônico e convencional. **Semina**: **Ciências Agrárias**, Londrina, v. 26, n. 3, p. 273-282, 2005.

BERNARDI ACC; VERRUMA-BERNARDI MR; WERNECK CG; HAIM PG;
MONTE MBM. Produção, aparência e teores de nitrogênio, fósforo e potássio em
alface cultivada em substrato com zeólita. **Horticultura Brasileira**, n.23, p. 920-924. 2005.

CARVALHO et al. **Anuário brasileiro de hortaliças 2013.** Santa Cruz do Sul: Gazeta, 2013.

COELHO, FERNANDES, S., **Fertilidade do solo**. Fernando S. Coelho e Flavio Verlengia, 2. Ed., Campinas, Instituto Campineiro de ensino agrícola, 1973.

CRUZ, A. P., EDUARDO, S. S. **Informaçãoes Agropecuarias: Nova missão novos tempos**. N°120, p.7, São Paulo, 2007.

EMBRAPA. **Sistema brasileiro de classificação de solos**. Brasília, 20013. 353p.

FAQUIN, V.; ANDRADE, A, T. **Nutrição Mineral e Diagnose do Estado Nutricional das Hortaliças**. Dissertação (Especialização/produção de hortaliças) – Universidade Federal de Lavras, 2004.

FERREIRA, V. P. **Doses e parcelamento de nitrogênio em alface.** Dissertação (Mestrado/Fitotecnia) – Universidade Federal do Rio Grande do Sul, 2002.

FILGUEIRA, F. A. R. **Novo manual de olericultura: agrotecnologia moderna na produção e comercialização de hortaliças**. Viçosa: UFV, 2003.

GOTO R; GUIMARÃES VF; ECHER MM. Aspectos fisiológicos e nutricionais no crescimento e desenvolvimento de plantas hortícolas. In: FOLEGATTI MV; CASARINI E; BLANCO FF; BRASIL RPC; RESENDE RS (coord) **Fertirrigação**: **flores, frutas e hortaliças**. Guaíba: Agropecuária, v.2, p.241-268. 2001.

HENZ, G. P.; SUINAGA, F. **Tipos de alface cultivados no Brasil.** Brasília: Embrapa, 2009.

MAPA. **Manual de hortaliças não-convencionais.** Brasilia: Mapa/ACS, 2010.

MELO SILVA, F.A. et al. Resposta da alface à adubação nitrogenada com diferentes compostos orgânicos em dois ciclos sucessivos. **Acta Scientiarum**. Agronomy, Maringá, v.32, n.1, p. 131-137, 2010.

OLIVEIRA, G.Q.; BISCARO, G.A.; JUNG, L.H., ARAÚJO, E.O. FILHO, P.S.V. Fertirrigação nitrogenada e níveis de hidrogel para a cultura da alface irrigada por gotejamento. **Engenharia na agricultura**, Viçosa, v. 22, n. 5, p. 456-465, 2014.

RESENDE, F. V. et al. **Cultivo de alface em sistema orgânico de produção.** Brasília: Embrapa, 2007.

RESENDE, G.M.; ALVARENGA, M.A.R.; YURI, J.E.; SOUZA, R.J. Rendimentos e teores de macronutrientes em alface americana em função de doses de nitrogênio e molibdênio. **Horticultura Brasileira**, Brasília, v.30, n.3, p.373-378, 2012.

TAIZ, L.; ZEIGER, E**. Fisiologia vegetal**. 5.ed. Porto Alegre: Artmed, 2013. 954p.

TERRA, S. B.; MARTINS, S. R.; FERNANDES, H. S.; DUARTE, G. B. Exportação de macronutrientes em alface cultivada no outono-inverno e na primavera com adubação orgânica em ambiente protegido. **Horticultura Brasileira**, Brasília, v.19, n.2, 2001. Suplemento CD-ROM.

TURAZI, C.M.V.; JUNQUEIRA, A.M. R.; OLIVEIRA, S.A.; BORGO, L.A. Acúmulo de nitrato em alface em função da adubação horário de colheita e tempo de armazenamento. **Horticultura Brasileira**, Brasília, v. 24, n. 1, p. 65-70, 2006.