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BRIEF COMMUNICATION

Gas exchange in lisianthus plants (*Eustoma grandiflorum*) submitted to different doses of nitrogen

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Abstract

The effect of different doses of nitrogen (N) on gas exchange, relative chlorophyll (Chl) amount, and the content of N in the aerial biomass of lisianthus was evaluated. The treatments consisted of six different concentrations of N (50, 100, 150, 200, 250, and 300 g m^{-3} noted as N_{50}, N_{100}, N_{150}, N_{200}, N_{250}, and N_{300}, respectively), applied through the fertirrigation technique. N_{250} and N_{300} induced increase in the contents of foliar Chl and N in the aerial biomass, that in turn contributed to an increase of photosynthetic activity in lisianthus.

Additional key words: chlorophyll; mineral nutrition; photosynthesis; stomatal conductance; transpiration.

Productivity reflects several physiological processes that happen in plants and are usually influenced and altered by management practices imposed to the crops (Gill and Narang 1993), as for instance, the management of the nitrogen fertilizing. The efficiency, the capacity of these physiologic processes, and even their resulting consequences are measurable. Net photosynthetic rate (P_N), CO_2 internal concentration (C_i), transpiration rate (E), stomatal conductance (g_s), relative content of chlorophyll (*SPAD*), content of foliar nitrogen, accumulation of dry mass, *etc*. reflect the physiological base of variation of the productivity (Mandal and Sinhá 2004). Photosynthesis is largely affected by the availability of N (Stocking and Ongun 1962, Larcher 1995, Dietz and Harris 1997, Lambers *et al*. 1998). The content of foliar N is positively correlated with the chlorophyll (Chl) amount in leaves, that is further correlated with photosynthesis and thus with the productivity of crop (Yadava 1986, Smeal and Zhang 1994, Schadchina and Dmitrieva 1995).

Lisianthus [*Eustoma grandiflorum* (Raf.) Shinn. (Gentianaceae)] is a perennial herbaceous ornamental species, original in the South of the United States, that is used as cut flower due to its big and attractive flowers, long stalks, and long duration in vases (Halevy and Kofranek 1984, Gill *et al*. 2000, Uddin *et al*. 2004). Its introduction in Brazil is recent and the cultivation aspects are incipient for the management of the species, inducing the Brazilian producers to look for information and recommendations from other countries.

In the literature, there is no information about the effect of doses of N in gas exchange of lisianthus. This is why we studied this effect on the gas exchange and contents of Chl and N in the aerial biomass of lisianthus.

The experiment was carried out in plastic greenhouse at Fazenda Experimental da Faculdade de Ciências Agronômicas da Universidade Estadual Paulista (UNESP), Campus of Botucatu, in São Manuel, SP, Brazil (latitude 25º51', longitude 48º34', and altitude 750 m). The plants were *E. grandiflorum* cv. Mariachi blue picotee sown on 15 March 2003 and transplanted on 3 June 2003 to vases of 1 300 cm^3 containing substrate with pinus peel (70 %), thick sand (10 %), and vermiculite (20 %), with the chemical composition as follows: N (14 %), P_2O_5 (18 %), K_2O (20 %), Mg (0.5 %), B (0.03 %), Cu (0.15 %), Fe (0.1 %), Mn (0.16 %), Mo (0.2 %), and Zn (0.1 %). The weighing method was used for the management of irrigation (Klar *et al*. 1991).

The six treatments were arranged in a completely randomized design in subdivided plots, with five replications of 20 vases each (2 plants per vase). The treatments consisted of six different concentrations of N

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(50, 100, 150, 200, 250 and 300 g m^{-3}, noted as N_{50}, N_{100}, N_{150}, N_{200}, N_{250}, and N_{300}, respectively) supplied in solutions into the vases through containers pet, with a dripping micro tube fastened in one of the extremities, with outflow of 0.56 $cm^3 s^{-1}$. The time of fertirrigation was determined by the evapotranspiration, the results were obtained by the weighing method. In the blossom stage, two foliar pulverizations with sodium molybdate (0.7 kg m^{-3})

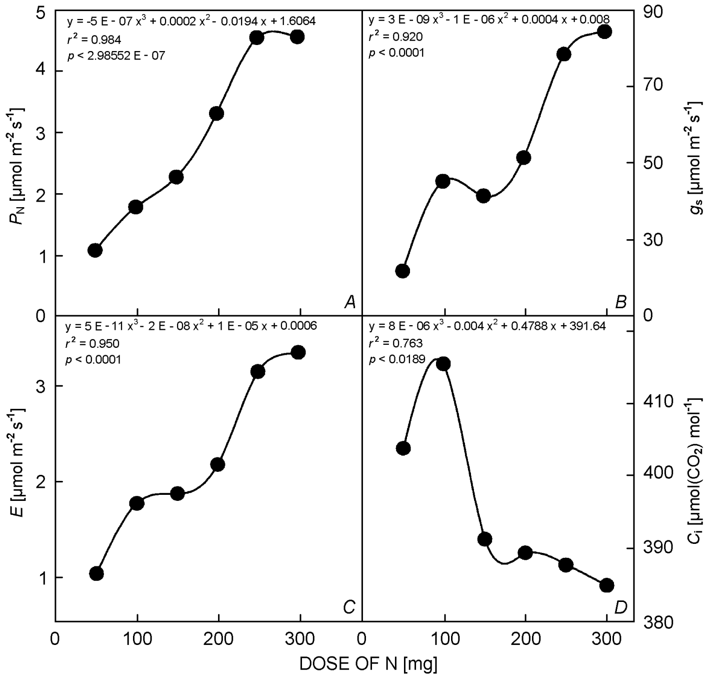

Fig. 1. Medium values for the net photosynthetic rate, P_N (*A*), stomatal conductance, g_s (*B*), transpiration rate, *E* (*C*), and CO_2 internal concentration, C_i (*D*) in response to different doses of nitrogen in *Eustoma grandiflorum*.

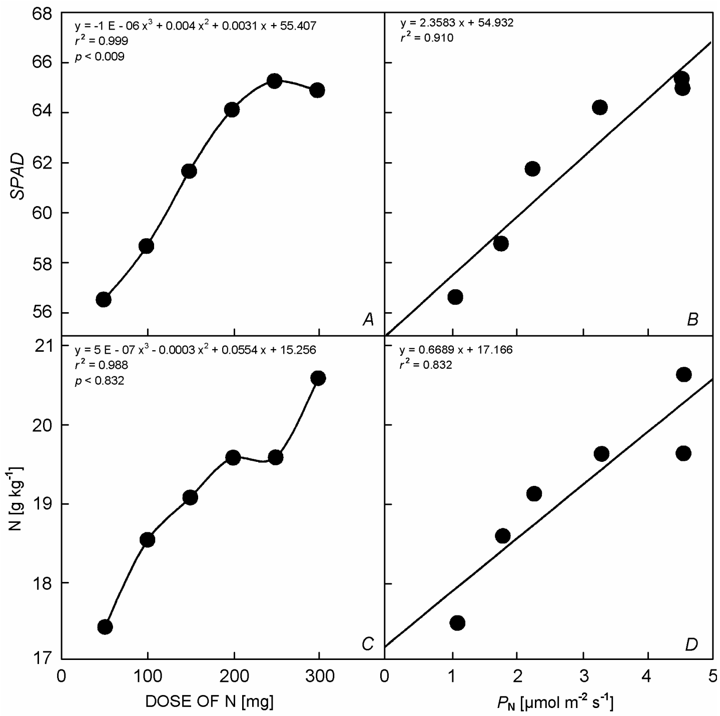

Fig. 2. Medium values of the relative chlorophyll content in the leaves, *SPAD* (*A*) and nitrogen in the aerial biomass (*C*) of *Eustoma grandiflorum* and their correlations with the net photosynthetic rate, P_N (*B*, *D*) in response to different doses of nitrogen.

were applied 3 and 33 d after the "pinch" (break of the apical dominance). The lisianthus demands calcium: to prevent the deficiency, weekly leaf pulverizations were applied of calcium chloride in the dosage of 2 kg m^{-3}(water) on 18 August 2003, 27 August 2003, and 4 September 2003, and 3 kg m^{-3} on 11 November 2003, 17 November 2003, and 25 November 2003.

Between 09:45 and 11:15 on 20 August 2003 the canopy gas exchange was measured in 5 plants of each treatment using a *LI-6200* portable photosynthetic system (*LI-Cor*, Lincoln, NE, USA). The conditions during the measurements were: mean photosynthetically active radiation (PAR) of 1 441.6 µmol m^{-2} s^{-1}, temperature of the air inside of the photosynthetic chamber of 31.28 ºC, medium deficit of steam pressure of 8.69 kPa, relative humidity of 53 %, and external CO_2 concentration of 282.3 mol(CO_2) mol^{-1}. In the same day, Chl amount was checked in 30 plants of each treatment using the hand-held Chl meter *SPAD-502* (*Minolta Camera Co*., Osaka, Japan). The total N content was determined in the aerial biomass through the semi-micro Kjeldahl method (Malavolta *et al*. 1997). All data were submitted to analysis of variance and regression analysis by orthogonal polynomials with the program *Sigma Plot® 8*.

The increasing doses of N elevated P_N in lisianthus, with values of 4.54 and 4.56 µmol m^{-2} s^{-1} for N_{250} and N_{300}, respectively (Fig. 1*A*). The increment of P_N was associated to the largest consumption of internal CO_2 (C_i) and to the increase in E and g_s (Fig. 1*B,C,D*). The found values of P_N are typical of plants with C_3 metabolism. If compared with other C_3 species, even at N_{300}, the P_N was fairly low, close to the values found for shade plants or facultative sun plants. This affirms that lisianthus belongs to shade or optional sun plants. The increase of N doses provoked an elevation in the relative Chl content in lisianthus leaves (Fig. 2*A*). According to Dietz and Harris (1997) the deficiency of N causes reduction in the Chl content in vegetables. The elevation of Chl content was associated to the increase in P_N ($r^2 = 0.910$; Fig. 2*B*).

The content of N in aerial biomass was also positively affected by the increase of N doses (Fig. 2*C*). The elevation of N content in the aerial biomass was also associated to the increase in P_N ($r^2 = 0.832$; Fig. 2*D*). According to Larcher (1995), Dietz and Harris (1997), and Lambers *et al*. (1998) the elevation in the content of N in the leaves increases linearly with P_N. This relationship is attributed to the fact that most of N of the leaves is constituent of enzymes such as ribulose-1,5-bisphosphate carboxylase/oxygenase (Stocking and Ongun 1962, Chapman and Barreto 1997, Dietz and Harris 1997). Especially N_{250} and N_{300} provoked an increase in the contents of N of the aerial biomass and of leaf Chl.

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