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DAILILY CULTIVAR REGINA FLOWERING UNDER DIFFERENT NPK DOSES

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ABSTRACT - The knowledge of fertilization in ornamental plant production is essential to improve productivity and longevity of plants and their flowers. In the case of *Hemerocallis* x *hybrida* Hort. there is only few studies showing this relation. The lack of research in the field led the execution of this study, which aimed to evaluate the effect of different doses of NPK on the growth of daylily cultivar Regina. The study was conducted in an experimental area at Pontifícia Universidade Católica do Paraná, located in Toledo, PR, Brazil. Seedlings were obtained from dividing the parent plants' clumps which were cultivated in a clonal garden. Subsequently, standardization was carried out regarding the length of the aerial part of 10 cm and root system of approximately 5 cm. The experimental design used was randomized blocks with five treatments, containing four replications with five plants each. The treatments consisted of five doses (0; 4.5; 9.0; 13.5 and 18.0 g pl^{-1}) using NPK (4-14-8). The parameters evaluated were number of shoots per plant, number of leaves per shoot, number of stems per plant, length of stems per plant and number of flower buds per stems. We observed the flowering timing was influenced by the different doses of NPK. There was linear fit for the parameters and the dose of 18 g pl^{-1} promoted the best results, except for the number of stems per plant. The results indicate that increasing doses of NPK positively influence the flowering period, and promote an increase in the number of shoots, stem length and number of flower buds.
Keywords: *Hemerocallis* x *hybrida* Hort, fertilizing, floriculture.

FLORESCIMENTO DA CULTIVAR REGINA DE HEMEROCALE SOB DIFERENTES DOSES DE NPK

RESUMO - O conhecimento da adubação na produção de plantas ornamentais é fundamental para uma melhoria na produtividade e longevidade da planta e das flores. No caso do *Hemerocallis* x *hybrida* Hort., ainda são poucas as pesquisas nessa área, o que levou a execução deste trabalho, que teve como objetivo avaliar o efeito de diferentes doses de NPK no desenvolvimento de Hemerocale cultivar Regina. O experimento foi conduzido em uma área experimental da Pontifícia Universidade Católica do Paraná, *Campus* Toledo. Mudas foram obtidas da individualização de touceiras provindas de plantas matrizes cultivadas de um jardim clonal. Posteriormente, realizou-se a padronização quanto ao comprimento da parte aérea 10 cm e sistema radicular com aproximadamente 5 cm. O delineamento experimental utilizado foi em blocos casualizados, com cinco tratamentos, contendo quatro repetições com cinco plantas cada. Os tratamentos consistiram em cinco doses (0; 4,5; 9,0; 13,5 e 18,0 g pl^{-1}), utilizando a formulação de NPK (4-14-8). Os parâmetros avaliados foram: número de brotações e hastes por planta, número de folhas por brotações, comprimento de hastes por planta e número de botões florais por haste. Observou-se que o período de florescimento foi influenciado pelas diferentes doses de NPK, o qual apresentou um ajuste linear para os parâmetros avaliados e a dose de 18 g pl^{-1} promoveu os melhores resultados, exceto para o número de hastes por brotação. Conclui-se que doses crescentes de NPK influenciam positivamente o período de florescimento, e promovem um aumento no número de brotações, comprimento da haste e número de botões florais.
Palavras-chave: *Hemerocallis* x *hybrida* Hort., adubação, floricultura.

INTRODUCTION

The flower and ornamental plants market has expanded virtually around the world over the years. In traditional consumer countries and developing country economies, demand for these products has grown significantly (JUNQUEIRA; PETZ, 2014). Brazil has a production and commercialization of ornamental plants which has been following the global trend, being benefited by soil conditions, relief, humidity, and temperature range that allows the production of several plant species (PETRY; BELLÉ, 2008; JUNQUEIRA; PETZ, 2014).

Hemerocallis x hybrida Hort., known just as hemerocale, San-Jose lily or daylily, is an example of a plant that recently has gained attention by producers and consumers. It is an ornamental plant from Asia, with a wide use in landscaping, cooking and medicine. According to Tombolato (2004) and Giulia et al. (2009) daylily requires low maintenance, tolerates periods of drought, adaptability to different types of soils and climate and resistance to pests and diseases. In Brazil, daylily can be planted throughout the entire year, being most indicated during the month of October. It is a full sun plant, but it also adapts to half shade. It shows good growing rate in well-drained soils with clay-

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sandy texture and organic matter content, with pH in the range of 5.5 to 7.0 (GIULIA et al., 2009).

In order to an ornamental plant crop be competitive, sustainable and economically feasible, its productivity is imperative, which can be obtained with an adequate management of environmental factors. However, information about daylily cultivation is scarce. Among the environmental factors, knowledge of the nutritional needs of the crop are extremely important for improvement in productivity and longevity of the plant, especially of its flowers (SILVA et al., 2015). Tombolato (2004) describes the most required nutrients by plants are phosphorus (P) and nitrogen (N). According to this author nitrogen is important to keep the foliage very green and vigorous, and phosphorus is essential in the beginning of flowering during spring season. However, information on fertilization of ornamental plants is very limited, mainly for herbaceous plants such as daylily.

Tombolato (2004) also recommends two fertilizations during the year in Brazil, one in the middle of winter, in August when the formation of the stems and flower buds occurs, using the formulation NPK (4-14-18), and the other, in autumn in mid-March, when fruit formation occurs, using the formulation NPK (10-10-10).

In view of the foregoing, the present study aimed to evaluate the effect of different NPK doses on the growth of daylily cultivar Regina.

MATERIAL AND METHODS

The study was conducted from May 2019 to February 2020, in an experimental unit of the Pontifícia Universidade Católica do Paraná (PUCPR), located in Toledo, PR, Brazil, at 24º43'49"S, and 53º44'35"W and altitude of 574 m, soil classified as Eutrophic Red Latosol (ERL) (SANTOS et al., 2011).

One month before planting, soil preparation was performed with plowing, followed by application of chicken manure, at the dose of (2 kg m^{-2}) performed in the entire area. Subsequently, the planted sites measuring 25 m long and 1 m wide were elevated at 15 cm in height.

The plants used in the study were the daylily cultivar Regina (Figure 1A), whose seedlings were obtained from matrices plants grown in a clonal garden of PUCPR. Daylily clumps were divided into individual seedlings, and subsequently, the shoot and root system were pruned, leaving respectively 10 cm and 5 cm in length (Figure 1B).

FIGURE 1 - A. *Hemerocallis* x hybrida Hort. cultivar Regina, **B.** Daylily seedlings.

After seedlings were prepared, they were planted at 30 x 30 cm spacing. Fertilization was also performed at this time, applying 4.5 g pl^{-1} of NPK 10-10-10. After 30 days fertilization was again performed with NPK 4-14-8. In order to maintain soil moisture and protect it from weed invasion, sawdust was spread in the corridors between plant beds. Irrigation was done twice a week, for a period of 1 h using a sprinkler irrigation system. During the experiment plants had rust (*Puccinia hemerocallidis*) infestation and needed fungicide application (2 g L^{-1} of Unizeb Gold®). The experimental design was randomized blocks with five treatments, each containing four replicates with five plants. The treatments consisted of five doses of NPK 4-14-8 (0; 4.5; 9.0, 13.5 and 18.0 g pl^{-1}).

The traits were assessed visually such as number of shoots per plant, number of leaves per sprout, number of stems per plant, length of the stem (cm) and number of flower buds per stem. The length (cm) was taken with a measuring tape, measured from the lowest part of the plant (close to the ground level) to the upper end of the stem. The number of flower buds was counted throughout the flowering period. The counts of number of leaves, shoots and stems were performed at the end of the flowering period (250 days after planting).

The data obtained were submitted to statistical analysis using ANOVA test and when significant effects were detected between treatments, regression analysis was performed using the program SISVAR (Ferreira, 2011).

RESULTS AND DISCUSSION

Data collection began 123 days after planting (DAP), time when the plants started flowering, which last until the end of February 2020 (Table 1), i.e., the plants remained flowering for a period of six months. These results agree with Tombolato (2004) who mentions that in the South and Southeast regions of Brazil, the flowering of

daylily begins in October and lasts until the beginning of April.

The different fertilization doses influenced the beginning and end of daylily flowering. Plants that received only fertilization of NPK 10-10-10 (control) at the time of planting flourished at 184 DAP, while plants that received a dose of 4.5 g of NPK (4-14-8) started flowering at 174 DAP. We also observed that as the dose of NPK applied increased, the number of days for the plant to start flowering decreased, reaching 116 days at the highest dose studied (18 g). Similar results were obtained by Rosa et al. (2013) using a dose of 539 kg ha^{-1} of P_2O_5 the authors obtained *Hemerocallis fulva* L. flowering at 415 DAP. The same authors also found they could decrease this period increasing fertilization, reaching flowering 406 DAP in the highest dose studied.

TABLE 1 - Flowering period in plants of *Hemerocallis x hybrida* Hort cultivar. Regina, submitted to NPK (4-14-8) doses, beginning of flowering (BF), flowering period (FP) and end of flowering (EF).

Treatments NPK (4-14-8)	BF	FP	EF
Control	184 DAP	72 days	256 DAP
4,5 g pl^{-1}	174 DAP	78 days	252 DAP
9,0 g pl^{-1}	128 DAP	133 days	261 DAP
13,5 g pl^{-1}	123 DAP	143 days	266 DAP
18 g pl^{-1}	116 DAP	159 days	275 DAP

Regarding the number of shoots per plant, leaves per sprout, flower buds per plant, and floral stem length, we found that different doses of NPK (4-14-8) showed a significant effect at 5% probability of error. We also found the number of shoots per plant had a linear adjustment with a value of R= 84%, as the dose of fertilization increased there was an increase in the number of new shoots (Figure 2A).

When 18 g pl^{-1} of NPK was applied, 3,75 shoots were observed, while in the control plants, which only received fertilization at planting time, 2,2 shoots were observed. We must highlight that daylily is an ornamental plant used most as ground cover, the aerial part is a fundamental issue for its commercialization and planting. Similar results were obtained by Silva et al. (2015). The authors used 400 kg ha^{-1} of P_2O_5 and 152 kg ha^{-1} of N and they obtained 27 tillers in *H. Fulva* plants. According to Bellé (2008), this increase in the number of shoots is because phosphorus stimulates root growth, and it is very important in the initial growth of seedlings. It is also involved in most metabolic processes of the plant, energy requirement, enzymatic processes, and carbohydrate transport (TAIZ et al., 2017).

The number of leaves per shoot was also significant having an increasing linear regression, with R = 94%. The lowest value was observed in the control (12,37 leaves per sprout), and the highest value was obtained at the dose of 18 g of NPK 4-14-8 with 18,64 leaves per sprout) (Figure 2B). This increase in the number of leaves may also be associated with the effect of phosphorus along with nitrogen presented in the NPK formulation. Mengel and Kirby (2000) mention that nitrogen, a primary macronutrient essential for plants, participates in the synthesis of proteins, amino acids, and other important compounds in plant metabolism.

The number of stems per plant showed no significance in the regression analysis (Figure 2C). The lowest mean was observed for the control (2,3 stems per plant), while the highest mean was observed at the dose of 18 g pl^{-1} (4,1 stems per plant). Possibly the emission of shoots may have interfered in the result of this parameter since the plant had a higher energy expenditure in the emission of sprouts.

As we observed for other parameters, the length of the stems had a significant effect with different NPK doses, and an increasing linear adjustment, with R= 86%. The longest stem length (63,72 cm) was obtained at a dose of 18 g pl^{-1} (Figure 2D). This shows that fertilization with NPK has a positive effect on plant development, as verified with the increment in growth. The beneficial effect of fertilization with phosphorus on the length of floral stem in *H. fulva* was observed by Rosa et al. (2013). Their study presented plants with higher stems (60 cm) when applying 363 kg ha^{-1} of P_2O_5. Hoshino et al. (2016) also verified a positive effect of phosphorus when using ultra soluble mineral fertilizer in Cattalianthe orchid (3g L^{-1}) when adding 50 mL of diluted fertilizer per plant pot, an increase of up to 42% in stem length occurred. The results obtained in our study evidence the same findings. Campos et al. (2016), analyzing the effect of NPK fertilization in sunflower, verified that the addition of 120 kg ha^{-1} provided an increase in the size of the stem, resulting in the longest length of plant stem (108,9 cm).

As for the number of flower buds per stem, we observed that there was a significant effect on the increasing linear regression, with R = 96% (Figure 2E). The treatment with the highest number of flower buds was 18 g pl^{-1} of NPK (4-14-8) with 18 flower buds per stem. These results agree with Tombolato (2004), who reports that phosphorus is indispensable at the beginning of flowering. Rosa et al. (2013) observed a significant increase for the dose of 119 kg ha^{-1} of P_2O_5 resulting in a maximum of 12 floral buds per stem with 1000 kg ha^{-1} in *H. fulva*. Also in accordance, Freitas et al. (1999) obtained an increase of 3,83% in the number of flowers in the first floral stem in *Hemerocallis liliaphodellus* L. using potassium nitrate fertilization every day for 20 days.

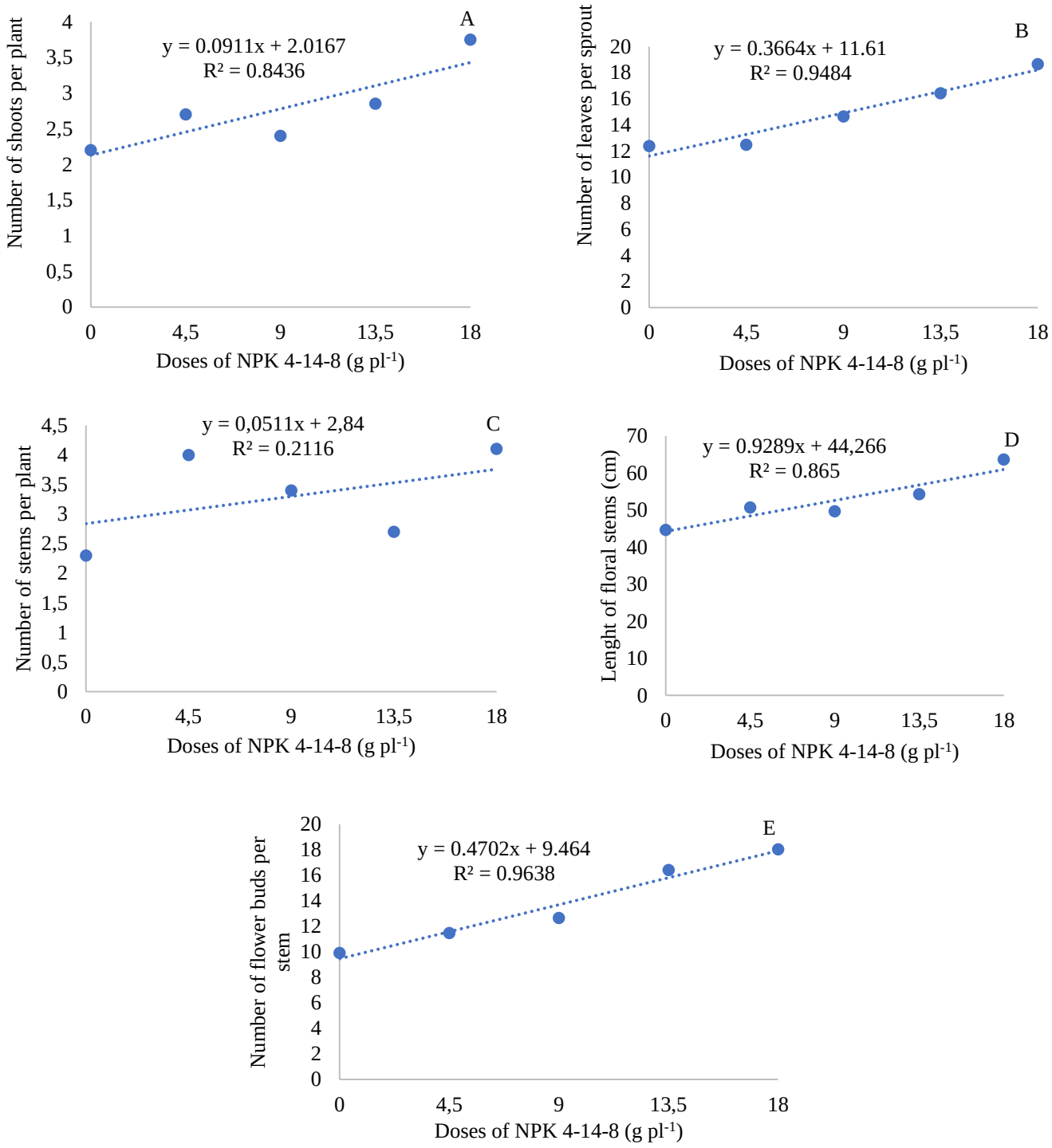

FIGURE 2 - Morphological characteristics of *Hemerocallis x hybrida* Hort. cultivar. Regina, submitted to doses of NPK (4-14-8). **A**: number of shoots per plant, **B**: number of leaves per sprout, **C**: number of stems per sprout, **D**: length of floral stems, **E**: number of floral buds per stem.

In view of what was described in this study, we emphasized that further studies should be conducted in order to verify the effect of different doses of nitrogen and phosphorus on the growth and development of daylily.

CONCLUSIONS

Increasing doses of NPK positively influence the flowering period, and promote an increase in the number of shoots, stem length and number of flower buds.

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