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Nutritional Behavior of Heliconia Grown Under Different Levels of Lime

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Abstract

Production and commercialization of tropical flowers and plants has grown in recent years, mainly due to the increasing value of these products in temperate climate countries, such as heliconia, one of the most cultivated tropical ornamental plants in Brazil. This study was developed to determine the effect of lime applications on the nutrients in heliconia plants (*Heliconia psittacorum* L. × *Heliconia sparthocircinata* Arist. [cv. Golden Torch]) cultivated in yellow latosol in a greenhouse. The macronutrient levels in the leaves, pseudostem and roots of the heliconia plants were determined after cultivating the plants in containers with a medium texture, yellow latosol, collected from the 0 to 20 cm layer and submitted to doses of 0, 0.9, 2.6, 4.2 and 5.9 t of lime ha^{-1}. Nitrogen and phosphorous performed better in the absence of the correction and in the 0.9 t ha^{-1} dose for the vegetative parts of the heliconia plants. The application of dolomitic lime promoted greater absorption of potassium, calcium and magnesium, and sulfur performed better for the doses 2.6 and 5.9 t of lime ha^{-1}, for the pseudostem and roots, respectively.

Keywords: *Heliconia spathocircinata*, limestone, mineral nutrition, tropical flower

1. Introduction

Heliconia psittacorum × *H. spathocircinata* Aristeguieta is an herbaceous plant that forms clumps and has an underground rhizome. It has an erect, terminal inflorescence with four to eight orangish-yellow bracts and yellowish flowers. The intense and often very contrasting colors make this plant attractive to the consumer. It is often used in gardens and as a cut flower in floral arrangements and has a light inflorescence with bracts deposited in the same plane, allowing it to be stored and transported in boxes (Loges et al., 2005; Castro & Gonçalves, 2007).

Heliconia is one of the most cultivated ornamental plants in the Northeast Region of Brazil, and Pernambuco, Alagoas and Ceará are the main exporting states (Aki & Pedrosa, 2002; Junqueira & Peetz, 2007). Among Heliconia cultivars, Golden Torch is notable for being productive and flowering throughout the year and is the most commercialized cultivar in the world (Castro & Gonçalves, 2007). This cultivar tolerates acidic soils (a pH between 4.5 and 6.5 is adequate for cultivation) and nitrogen, phosphorous, potassium, magnesium, iron and manganese are the nutrients it demands the most (Lamas, 2004). Although fertilizing is one of the factors that most influences production, quality and resistance to diseases, studies about the effect of soil fertility are still scarce for this cultivar (Cerqueira et al., 2008; Castro et al., 2015).

Lime can be important because it increases the pH, directly influencing the availability of nutrients, such as K, Ca, Mg, N, S and P that are less available when the pH is low. Thus, the objective of this study was to determine the effect of applying doses of dolomitic lime on macronutrient levels in heliconia plants (*Heliconia psittacorum* L. × *Heliconia spathocircinata* Arist., cv. Golden Torch) cultivated in a medium texture, yellow latosol, in the municipality of Belém, PA.

2. Material and Methods

2.1 Research Methodology

The study was conducted in a greenhouse in the municipality of Belém, PA. The experiment was a completely randomized design with five treatments and five replicates. The heliconia plants (*Heliconia psittacorum* L. × *Heliconia sparthocircinata* Arist. [cv. Golden Torch]) were cultivated in 20 dm³ plastic containers, which were the experimental units. There were five treatments: 0, 0.9, 2.6, 4.2 and 5.9 t of lime ha^{-1}, being the rate 0 t ha^{-1} the control treatment, and the rest aimed to increase the base saturation of the soil (V%) to 20, 40, 60 and 80%, espectively. The soil used in the experiment was a medium texture, yellow latosol. The chemical characteristics of lime were the following: 32% CaO, 13% MgO, 67% PN and 85.16% PRNT.

2.2 Soil Preparation

First, the soil was incubated for 30 days with the lime, according to the treatments, in 20 dm³ plastic containers. After incubation, heliconia rhizomes were planted which had a stem that was approximately 15 cm. The plants were fertilized with an application of 150 mg of N kg^{-1}, 50 mg of P kg^{-1}, 125 mg of K kg^{-1} and 30 mg of $NaSO_4$ kg^{-1} at 30, 60 and 90 days after planting, in addition to an application of 0.5 mg of H_3BO_3 kg^{-1}, 1.0 mg of $CuSO_4$ kg^{-1}, 2.0 mg of $MnSO_4$ kg^{-1} and 2.0 mg of $ZnSO_4$ kg^{-1}, 30 and 60 days after planting. The containers were watered every two days and the saturation humidity was maintained at 60%.

Two hundred and ten days after planting, the plants were collected and separated into different parts (leaves, pseudostem and roots), put in paper bags and placed in a forced air circulation dryer, maintained at 70 ºC, until a constant weight was reached. Subsequently, the dry material of each plant part was weighed. The material was then ground with a Willey mill (2 mm mesh sieve) and chemically analyzed to determine the N, P, K, Ca, Mg and S macronutrient concentrations in the dry mass of the leaves, pseudostem and roots. The macronutrients N, P, K, Ca, Mg, and S were determined based on the procedure in Silva (2009). The results were subjected to an analysis of variance and, when significant, a regression analysis.

3. Results and Discussion

The nutrient levels in the heliconia plant parts were modified by lime applied to the soil (Table 1). The application of 0.9 t lime ha^{-1} was responsible for the highest level of N in the leaves and pseudostem. For the roots, the highest level was obtained without applying lime and N levels decreased as the dose increased.

Table 1. N, P, K, Ca and Mg contents in leaves, pseudostem and roots in *Heliconia psittacorum* L. × *Heliconia* 66 *spathocircinata* Arist. cv. Golden Torch at 210 days of age, due to limestone doses

Content	Part Vegetative	Doses in limestone (t ha^{-1})					MSE[1]	Regression equation
		0	0.9	2.6	4.2	5.9		
N (g kg^{-1})	Leaves	28.8	29.2	26.1	23.8	25.0	1.1	$\hat{Y} = 29.580 - 1.772x + 0.154x^2$
	Pseudostem	17.0	18.6	16.7	16.1	15.0	1.1	$\hat{Y} = 17.534 + 0.136x + 0.097x^2$
	Roots	32.5	28.2	18.9	15.2	12.8	0.9	$\hat{Y} = 33.044 - 7.079 + 0.699x^2$
P (g kg^{-1})	Leaves	6.8	8.1	6.1	6.2	6.3	1.0	$\hat{Y} = 7.355 - 0.363x + 0.028x^2$
	Pseudostem	4.7	2.6	3.6	4.3	3.9	0.6	$\hat{Y} = 4.002 - 0.426x + 0.079x^2$
	Roots	4.9	2.9	3.8	4.5	5.0	0.7	$\hat{Y} = 4.328 - 0.672x + 0.139x^2$
K (g kg^{-1})	Leaves	8.9	10.8	9.6	10.1	10.9	0.9	$\hat{Y} = 9.556 - 0.149x + 0.007x^2$
	Roots	6.1	7.2	7.2	8.9	8.6	0.4	$\hat{Y} = 6.245 + 0.642x + 0.031x^2$
Ca (g kg^{-1})	Leaves	3.2	3.8	5.4	8.0	6.2	1.0	$\hat{Y} = 2.809 + 1.656x + 0.166x^2$
	Pseudostem	3.0	3.9	5.2	6.6	6.6	0.3	$\hat{Y} = 2.969 + 1.128x + 0.082x^2$
	Roots	3.5	4.6	4.8	5.7	5.9	0.3	$\hat{Y} = 3.696 + 0.627x + 0.043x^2$
Mg (g kg^{-1})	Leaves	1.2	1.6	3.1	3.3	3.6	0.4	$\hat{Y} = 1.106 + 0.884x + 0.080x^2$
	Pseudostem	1.6	3.8	5.8	8.6	8.5	0.8	$\hat{Y} = 1.709 + 2.175x + 0.168x^2$
	Roots	1.2	3.3	6.2	10.6	11.8	0.5	$\hat{Y} = 1.201 + 2.263x + 0.072x^2$

Note. [1]MSE: Mean Standard Error.

Bratti et al. (2012) evaluated the level of N in gladiolus leaves after applying lime, and showed that doses over 2.05 t ha^{-1} promoted the absorption of N; they obtained a maximum level of 12.9 g kg^{-1} of N with a dose of 8 t

ha^{-1}. According to these authors, lime facilitates the mineralization of nitrogen, making it easier for the plant to use the nutrient. In the present study, however, it was found that the N content in leaves, pseudostem and roots available to the heliconia plants were not influenced by the increase of lime applied.

The highest levels of P (8.1 g kg^{-1}) and K (10.8 g kg^{-1}) in the leaves were obtained with the application of 0.9 t lime ha^{-1}. The level of P in the pseudostem and roots was not statistically significant among the doses of 0, 2.6, 4.6 and 5.9 t lime ha^{-1}; the values of P for the lowest and highest dose being 4.7 and 3.9 g kg^{-1} in the pseudostem and 4.9 to 5.0 g kg^{-1} in the roots. The lowest levels of P in the pseudostem and roots (2.6 g kg^{-1} and 2.9 g kg^{-1}, respectively) were observed for the application of 0.9 t lime ha^{-1}.

The P is fundamental in the export of carbon in the leaves (source) through the sinks during the reproductive period of the plant and the carbohydrates are used as energetic resource during that period (Pieters et al., 2001; Yee & Tissue, 2005). According to Castro et al. (2015), P can directly influence the level of carbohydrates in the floral stem of heliconia.

The levels of Ca and Mg in the vegetative parts can be explained by the fact that the chemical composition of lime includes 32% CaO and 13% MgO. The highest level of Ca in the leaves was observed for the application of 4.2 t lime ha^{-1}. For this dose of lime, elevated levels of Ca were also observed in the pseudostem and roots, which was not significantly different from that observed for 5.9 t lime ha^{-1}. In the pseudostem and roots, the Ca levels for the doses 4.2 and 5.9 t ha^{-1} varied considerably. For the level of Mg in the leaves, there was a significant increase starting with the application of 2.6 t lime ha^{-1} which did not highly change for other higher doses. In the pseudostem, the highest levels (8.6 and 8.5 g kg^{-1}) were obtained with the application of 4.2 and 5.9 t lime ha^{-1}. In the roots, the highest levels of Mg were obtained when applying the highest dose of lime.

The levels of K in the heliconia plants, with the application of the dolomitic lime differ from the results of other studies of species of cut flowers (Bratti et al., 2012). According to Malavolta (2006), the antagonism between K and Ca is a result of competition in the soil solution. At low concentrations Ca can have a stimulating effect on the absorption of K; however, increasing the Ca concentration decreases the stimulus until the interaction between these cations becomes antagonistic, causing a reduction in the absorption of K by the plants (Soares et al., 1983).

Applying lime increases the pH, neutralizes aluminum, provides calcium and magnesium and promotes the development of the root system, improving efficiency in the use of nutrients and water in the soil (Faquin, 2005). This explains the higher levels of Ca and Mg with the increase in the dose of lime applied.

4. Conclusions

The application of dolomitic lime to medium textured, yellow latosol promotes changes in the nutrient levels in the leaves, pseudostem and roots of plants of *Heliconia psittacorum* L. × *Heliconia sparthocircinata* Arist. cv. Golden Torch.

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