STEM DIAMETER OF TAQUARA BAMBOO (*Bambusa tuldoides*) FERTILIZED WITH POTASSIUM AND ZINC

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ABSTRACT: The Americas detain 30% of the total bamboo species, and Brazil is the country holding the greatest diversity. However, studies into the characterization and evaluation of bamboo species fertilized with potassium and zinc are scarce. The objectives of this work were to assess stem diameter of Taquara plants (*Bambusa tuldoides*) fertilized with potassium and zinc. The experimental design was randomized block, in a split-split-plot arrangement (2 × 2 × 4) with three replications, with two potassium rates in the plots (0 and 80 kg ha^{-1}), two zinc rates in the subplots (0 and 5 kg ha^{-1}), and four evaluation times in the sub-subplots (60, 90, 120 and 150 days after sprouting). Morphological characteristic stem diameter was evaluated monthly. Stem diameter was measured in the middle third of the plant using a caliper ruler. The stem diameter of bamboo (*Bambusa tuldoides*) is maximized when fertilized with 80 kg ha^{-1} of K and 5 kg ha^{-1} de Zn.

KEYWORDS: growth; potassium chloride; zinc sulphate.

INTRODUÇÃO

The Americas detain 30% of the total bamboo species, and Brazil is the country holding the greatest diversity, so strategic partnerships aiming for the sustainable development of the bamboo's productive chain can enable Brazil to establish an effective economic, social and environmental growth based on this species (Almeida, 2006; Melo et al., 2015) and this due to its multiple uses.

Kumari and Bhardwaj (2017) when verifying the between different growth and soil physico chemical parameters viz., culm diameter, culm height, internodal length, number of culm per hectare, available N, P, K, exchangeable calcium, zinc and magnesium demonstrated that the most of the growth and soil physicochemical parameters positively correlate with each other.

The objectives of this work were to assess stem diameter of Taquara plants (*Bambusa tuldoides*) fertilized with potassium and zinc.

MATERIAL E MÉTODOS

The experiment was conducted under field conditions, at the experimental station of the Federal Institute of Goiás, in Rio Verde GO, Brazil (17°48'28"S, 50°53'57"W, and average altitude of 720 m). The climate of the region is classified as Aw (tropical), according to Köppen and Geiger (1928), with a rainy season from October to May and a dry season from June to September. The region presents mean annual temperature of 20 °C to 35 °C, mean annual precipitation of 1,500 to 1,800 mm, and slightly wavy relief (slope of 6%).

The soil of the experimental area was classified as dystroferric Red Latosol (Oxisol) (Embrapa, 2013). Undisturbed soil samples were collected form the 0.0-0.2 and 0.2-0.4 m layers for physical and chemical characterization (Table 1).

Table 1. Physical-chemical characteristics of a Dystroferric Red Latosol (Oxisol) (dfRL) soil collected from the 0.0-0.2 and 0.2-0.4 m layer.

Layer[1]	Ca^{2+}	Mg^{2+}	Ca+Mg	Al	H+Al	K^{+}	S	P	pH
m			$cmol_c\ dm^{-3}$				$mg\ dm^{-3}$		$CaCl_2$
0.0-0.2	5.6	0.9	6.5	0.0	3.1	133	7.5	3.6	5.8
0.2-0.4	2.8	0.5	3.3	0.0	2.9	142	9.1	1.7	5.8
Layer	Micronutrients								
	Na^{+}	Fe	Mn	Cu	Zn	B	CEC	SB	V%
m			$mg\ dm^{-3}$				$cmol_c\ dm^{-3}$		%
0.0-0.2	4.0	19.9	37.0	1.5	1.7	0.6	9.9	6.8	69
0.2-0.4	3.0	20.2	22.8	1.9	0.9	0.5	6.5	3.6	56
Layer	Texture				Relationship between bases				
	Clay	Silt	Sand	OM	Ca/Mg	Ca/K	Mg/K	Ca/CTC	Mg/CTC
m		%		$g\ dm^{-3}$	-	-	-	-	-
0.0-0.2	42	10	48	31.4	6.3	16.4	2.6	0.56	0.09
0.2-0.4	52	7	41	22.4	5.8	7.7	1.3	0.43	0.07

[1]Determination methods: P, K, Na, Cu, Fe, Mn. and Zn: Mehlich 1; Ca, Mg, and Al: KCl 1 N; S: Ca $(H_2PO_4)_2$ in HOAc; OM: calorimetry; B: $BaCl_2$. Cation exchange capacity (CEC); Sum of bases (SB); Saturation by bases (V%); Organic Matter (OM).

The experimental design was randomized block, in a split-split-plot arrangement (2 × 2 × 4) with three replications, with two potassium rates in the plots (0 and 80 kg ha^{-1}), two zinc rates in the subplots (0 and 5 kg ha^{-1}), and four evaluation times in the sub-subplots (60, 90, 120 and 150 days after sprouting).

Potassium and zinc fertilization were applied according to the treatments, using potassium chloride (K_2O), and zinc sulphate as sources, respectively. The soil of all treatments was fertilized with nitrogen (80 kg ha^{-1}; urea), phosphorus (80 kg ha^{-1}; triple superphosphate) and micronutrients, except zinc, according to soil analysis.

Morphological characteristic stem diameter was evaluated monthly. Stem diameter was measured in the middle third of the plant using a caliper ruler.

The data were subjected to analysis of variance by the F test at 5% probability level, and significant means were subjected to regression analysis considering the evaluation periods, and Tukey's test ($p<0.05$) considering the fertilizer rates, using the R program (R Core Team, 2015).

RESULTADOS E DISCUSSÃO

The stem diameter of Taquara plants fertilized with 0 and 80 kg ha^{-1} of K, with 0 and 5 kg ha^{-1} of Zn presented no differences at 60, 90, and 150 DAS. According to Almeida et al. (2015) the K doses affected plant height, however other growth variables as the stem diameter in a Dystrophic Red Latosol were not affected. However, at 120 DAS, only plants fertilized with 5 kg ha^{-1} of Zn presented no differences in stem diameter, whereas with absence of zinc fertilization, it increased 11.58% when applying 80 kg ha^{-1} of K (Table 3).

Table 3. The stem diameter (SD) and internal stem diameter (ISD) of Taquara plants (*Bambusa tuldoides*) fertilized with potassium and zinc

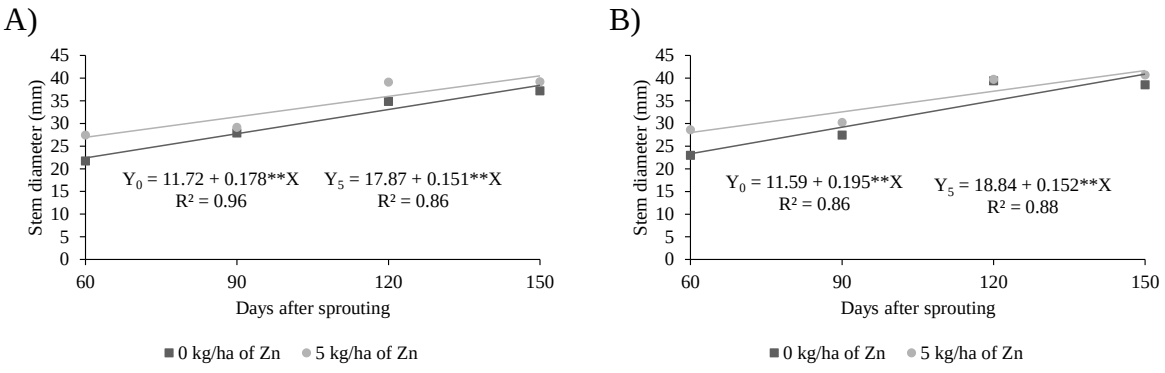
DAS	Zn (kg ha^{-1})	K[1] (kg ha^{-1})	
		SD (mm)	
		0	80
60	0	21.72 Ba	23.00 Ba
	5	27.43 Aa	28.64 Aa
90	0	27.89 Aa	27.44 Ba
	5	29.14 Aa	30.24 Aa
120	0	34.87 Bb	39.44 Aa
	5	39.11 Aa	39.74 Aa
150	0	37.19 Ba	38.54 Ba
	5	39.20 Aa	40.69 Aa

[1]Means followed by different letters, lowercase in the row and uppercase in the column, differ by Tukey test ($p < 0.05$).

The highest stem diameter was found in Taquara plants fertilized with 5 kg ha^{-1} of Zn. However, at 90 DAS without K fertilization, and at 120 DAS with K fertilization of 80 kg ha^{-1}, the stem diameter of Taquara plants presented no differences due to zinc rates.

Stem diameter increased 20.84%, 10.85%, and 5.13% due to zinc rate of 5 kg ha^{-1}, without K fertilization, at 60, 120, and 150 DAS, respectively. However, when using a K fertilization of 80 kg ha^{-1}, the increases in stem diameter due to zinc rate of 5 kg ha^{-1} were 19.68; 9.26, and 5.30%, at 60, 90, and 150 DAS, respectively. Badshah and Ayub (2013) verified that the maximum stem diameter was noted when plants were fertilized with zinc, while minimum stem diameter was recorded in plants without fertilization, indicating differences of 11.43%.

The stem diameter of Taquara plants fitted to a linear model with mean R^2 of 89% (Figure 3) as a function of days after sprouting, regardless of the K and Zn fertilization.



** F value significant at 1% of probability

Figure 3. The stem diameter of Taquara plants (*Bambusa tuldoides*) as a function of days after sprouting, fertilized with 0 and 5 kg ha^{-1} of Zn, with 0 (A) and 80 kg ha^{-1} (B) of K.

The regression equation showed increases in stem diameter of 13.90%, and 11.17% every 30 days for Zn rates of 0, and 5 kg ha^{-1}, respectively, without K fertilization (Figure 3A); and increases of 14.33% and 10.96% every 30 days for Zn rates of 0, and 5 kg ha^{-1}, respectively, when using a K rate of 80 kg ha^{-1} (Figure 3B).

The stem diameter of Taquara plants (*Bambusa tuldoides*) with K and Zn fertilization increased up to 150 DAS, when they reached the maximum stem diameter, approximately 41.67 mm. The stem diameter of bamboos was recorded maximum in *Dendrocalamus asper* (56.4 mm) which was statistically at par with *Bambusa polymorpha* (54.5 mm), *Bambusa nutans* (48.4 mm) and *Dendrocalamus strictus* (44.2 mm) whereas lowest in *Melocanna bambusoides* (29.8 mm), *Bambusa jantiana* (25.0 mm) and *Dendrocalamus dullooa* (24.7 mm) (Amlani et al., 2017).

CONCLUSÃO

The stem diameter of bamboo (*Bambusa tuldoides*) is maximized when fertilized with 80 kg ha^{-1} of K and 5 kg ha^{-1} de Zn.

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