

GROWTH AND DEVELOPMENT OF ‘TAQUARA’ BAMBOO IRRIGATED AND FERTILIZED WITH POTASSIUM AND ZINC

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1 ABSTRACT

The Americas detain 30% of the total bamboo species, and Brazil is the country holding the greatest diversity. However, characterization and evaluation studies of bamboo species fertilized with potassium and zinc are scarce. The goals of this work were to evaluate growth and development of ‘Taquara’ bamboo plants (*Bambusa tuldooides*) irrigated and fertilized with potassium and zinc. The experimental design was randomized block, in a split-split-plot arrangement ($2 \times 2 \times 4$) 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 characteristics: plant height, stem diameter, internal stem diameter, stem circumference area, number of internodes, and internode length-were evaluated monthly. Plant height and internode length were measured using a measuring tape; and stem diameter was measured in the middle third of the plant using a caliper ruler. The fertilization with potassium and zinc rates influences the growth and development of ‘Taquara’ bamboo plants (*B. tuldooides*), promoting increases in most of the analyzed variables.

Keywords: *Bambusa tuldooides*; potassium chloride; zinc sulphate.

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CRESCIMENTO E DESENVOLVIMENTO DO BAMBU TAQUARA IRRIGADO E ADUBADO COM POTÁSSIO E ZINCO

2 RESUMO

As Américas detêm 30% do total de espécies de bambu e o Brasil é o país que detém a maior diversidade. Entretanto, estudos sobre a caracterização e avaliação de espécies de bambu adubadas com potássio e zinco são escassos. Objetivou-se, no presente trabalho, avaliar o crescimento e desenvolvimento do bambu Taquara (*Bambusa tuldooides*) irrigado e adubado com potássio e zinco. O delineamento experimental utilizado foi em blocos ao acaso, analisado

em esquema de parcelas sub-subdividas $2 \times 2 \times 4$, com três repetições, as parcelas foram compostas por duas doses de potássio (0 e 80 kg ha^{-1}), as subparcelas por duas doses zinco (0 e 5 kg ha^{-1}) e as sub-subparcelas por quatro épocas de avaliações (60, 90, 120 e 150 dias após a brotação). As características morfológicas foram avaliadas mensalmente, quantificando-se: altura de planta (AP); diâmetro de colmo (DC); diâmetro interno do colmo (DI); área da circunferência do colmo (AC); número de entrenós (NE) e comprimento de entrenós (CE). A altura da planta e o comprimento de entrenós foram mensurados com auxílio de uma fita métrica; o diâmetro de colmos foi determinado pelo auxílio de um paquímetro no terço médio da planta. A adubação com doses de potássio e zinco influencia o crescimento e desenvolvimento do bambu Taquara (*Bambusa tuldooides*), promovendo incrementos na maioria das variáveis analisadas.

Palavras-chave: *Bambusa tuldooides*; cloreto de potássio; sulfato de zinco.

3 INTRODUCTION

Bambusa tuldooides Munro. is native to China and is widely cultivated in tropical and subtropical regions of America (GUERREIRO; LIZARAZU, 2010). The bamboo is a member of the Poaceae family, with 1,439 species, among them, the *Bambusa tuldooides* is a species of medium-sized and is widely used in the production of cellulose, while other species are used to control erosion, as forage, as ornamental plants and as a source of biomass for energy production (SUNGKAEW et al., 2009; BAMBOO PHYLOGENY GROUP, 2012; MORAIS et al., 2015; GENEROSO et al., 2016). The first record of the cultivation of *B. tuldooides* in South America was in Argentina by Parodi (1943), for Buenos Aires and the neighboring countries: Brazil, Chile, and Uruguay. The Americas detain 30% of the total bamboo species, and Brazil is the country holding the greatest diversity. 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 (OSTAPIV; FAGUNDES, 2007; MELO et al., 2015) due to its multiple uses and fast-growing behavior.

The bamboo growth has high positive correlation with the surface soil

depth and the mineral and organic matter contents of the soil; in addition to this, the nutrient content in soil is positively related to bamboo yield; this crop also makes efficiently use of the available nutrients and build up relatively fertile soil around the clumps, consequently it is evident the high potential of traditionally managed bamboos in sustaining productivity and restoring soil quality (SINGH; SINGH, 1999; SHANMUGHAVEL; PEDDAPPAIAH; MUTHUKUMAR, et al., 2001; KUMARI; BHARDWAJ, 2017).

Due to the stored nutrition in the bamboo plant be removed away from the soil by the means of the harvest of the bamboo trunk, which is the largest nutrition pool of the bamboo plant, fertilization with supplementary nutrients is strongly recommended to keep the productivity of bamboo high (WU et al., 2009; MERA; XU, 2014).

The bamboo exports roughly twice as much K than N, it is also worth mentioning that the mount of nutrients exported by bamboo is classified in the following order: $K > N > Ca > Mg > P > S$, consequently the fertilization programs for the studied species of bamboo must prioritize the supply of potassium, nitrogen, and calcium (LIMA NETO et al., 2010). In relation to micronutrients, it can be highlighted that the application of Zinc (Zn),

in Brazil, when used micronutrient fertilization, it is done empirically by the producer, without considering the specific crop need, this way, the amount of this micronutrient applied to meet the crop demand could not be adequate (SILVEIRA et al., 1996; MELO et al., 2017).

The K and Zn are important nutrients for bamboo, however, studies into the characterization and evaluation of bamboo species fertilized with potassium and zinc are scarce (GENEROSO et al., 2016; CUNHA, 2017). Therefore, it is important to determine the ideal amount of K and Zn that most favor the growth of Bamboo. The objectives of this work were to assess the growth and development of *Bambusa tuldooides* irrigated and fertilized with potassium and zinc.

4 MATERIAL AND METHODS

The experiment was conducted under field conditions at the Estrela do Norte farm, in Gurupi, TO, Brazil (11°53'24.4"S 49°06'47.1"W). The climate of the region is classified as Aw, according to Alvares et al. (2013) and Köppen (2013) classification. The region presents annual mean temperature of 27°C and annual mean precipitation of 1,600 mm. The soil of the experimental area was classified as Red Latosol (Oxisol) (EMBRAPA, 2013). Undisturbed soil samples were collected from 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 Red Latosol (Oxisol) soil collected from the 0.0-0.2 and 0.2-0.4 m layers.

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

¹Determination methods: P, K, Na, Cu, Fe, Mn, and Zn: Mehlich 1; Ca, Mg, and Al: KCl 1 N; S: Ca (H₂PO₄)₂ in HOAc; OM: calorimetry; B: BaCl₂. 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 fertilizations were applied according to the treatments, by using as sources, potassium chloride (K₂O) and zinc sulphate, 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, as recommended by Pereira and

Beraldo (2010). The spacing between the seedlings was 5 m × 5 m. The plants were irrigated using drip irrigation with a drip pipe network in the soil surface along the planting furrows, that showed the following characteristics: maximum working pressure of 1.5 bar; nominal thickness (mm) of 0.40 mm; spacing between emitters of 100 cm; internal diameter of 16.1 mm and external diameter of 16.9 mm.

Morphological characteristics: plant height, stem diameter, internal stem diameter, stem circumference area, number of internodes, and internode length were evaluated monthly. Plant height and internode length were measured using a measuring tape; and stem diameter was measured in the middle third of the plant by using a caliper ruler.

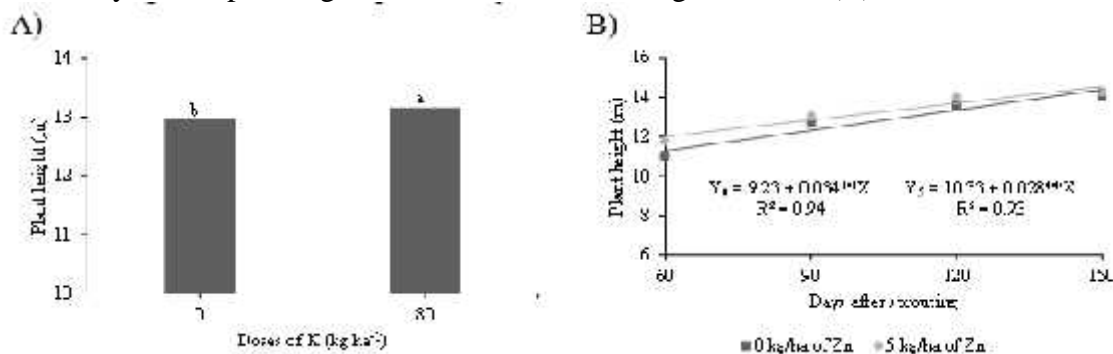
The data were subjected to analysis of variance by the F test at 5% probability

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, 2020).

5 RESULTS AND DISCUSSION

The plant height of the *B. tuldooides* without K fertilization was 1.5% lower than that with K rate of 80 kg ha⁻¹ (Figure 1A). The plant height as a function of days after sprouting (DAS) of plants with and without zinc fertilization fitted to a linear model, with R² above 93% (Figure 1B). Yen et al. (2010) and Yen (2016) observed a strong correlation between diameter at breast height and culm height for bamboos.

Figure 1. The plant height of *B. tuldooides* irrigated as a function of potassium rates (A) and days after sprouting for zinc rates of 0 and 5 kg ha⁻¹ of Zn (B).



** F value significant at 1% of probability

According to Prajapati and Swaroop (2016), treatments with K can show increments of up to 9% taller than the plants grown without K fertilization.

The regression equation showed increases in plant height of 7.17% and 5.79% every 30 days for Zn rates of 0 and 5 kg ha⁻¹, respectively (Figure 1B). Comparing 'Taquara' growth at 60 and 150 DAS in the Zn rates of 0 and 5 kg ha⁻¹, the plant height showed differences of 21.52% and 17.39%, respectively, in relation to the DAS.

'Taquara' plants fertilized with 5 kg ha⁻¹ of Zn presented plant height of 6.77%, 2.96%, and 2.87% higher than the plant height found in 'Taquara' plants without zinc fertilization, at 60, 90, and 120 DAS, respectively (Table 2). Devi and Ghosh (2017) showed that Zn fertilization promoted significantly higher maize plant height (3.44%) than plants without Zn. No difference in plant height was found at 150 DAS, probably, due to growth stabilization.

Table 2. The plant height of *B. tuldooides* irrigated and fertilized with zinc.

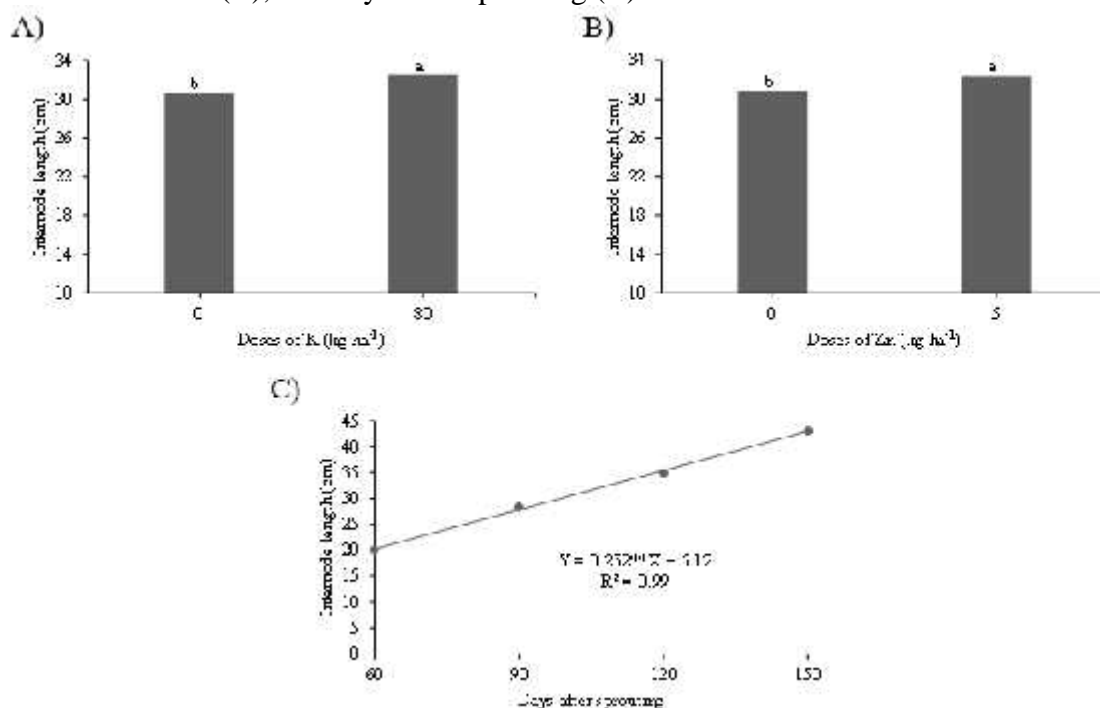
DAS ¹	Zn (kg ha ⁻¹)	
	Plant height (m)	
	0	5
60	10.97 b	11.77 a
90	12.69 b	13.07 a
120	13.60 b	14.00 a
150	14.11 a	14.27 a

¹Days after sprouting (DAS). Means followed by different letters, lowercase in the row, differ by Tukey test ($p < 0.05$).

Gul et al. (2011), studying the effect of nutrients on plant growth, observed that the maximum plant height was recorded in those plots with K and Zn fertilization. The authors explained that this might be due to the application of K and Zn provide increments on the stem length at boot stage, which in turn resulted in maximum plant height.

'Taquara' plants fertilized with 80 kg ha⁻¹ of K presented internode length of

5.77% higher than the internode length found in 'Taquara' plants without potassium fertilization (Figure 2A). The internode length of the *B. tuldooides* without Zn fertilization was 4.82% lower than that with Zn rate of 5 kg ha⁻¹ (Figure 2B). Plants without Zn fertilization usually show decreased internode length (AHMAD et al., 2012). The internode length of *B. tuldooides* showed increases of 17.62% every 30 days (Figure 2C).

Figure 2. The internode length of *B. tuldooides* irrigated as a function of potassium rates (A), zinc rates (B), and days after sprouting (C).

** F value significant at 1% of probability

The stem diameter of *B. tuldooides* 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. Almeida et al. (2015) also found effects of K doses on plant height; however, other growth variables as the stem diameter in a Dystrophic Red

Latosol were not affected. Although, 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 tuldooides*) irrigated and fertilized with potassium and zinc.

DAS	Zn (kg ha ⁻¹)	K ¹ (kg ha ⁻¹)			
		SD (mm)		(ISD) (mm)	
		0	80	0	80
60	0	21.72 Ba	23.00 Ba	8.91 Bb	9.76 Ba
	5	27.43 Aa	28.64 Aa	10.33 Aa	10.79 Aa
90	0	27.89 Aa	27.44 Ba	11.98 Aa	12.20 Ba
	5	29.14 Aa	30.24 Aa	12.14 Ab	14.65 Aa
120	0	34.87 Bb	39.44 Aa	15.57 Ba	15.72 Ba
	5	39.11 Aa	39.74 Aa	16.71 Aa	17.29 Aa
150	0	37.19 Ba	38.54 Ba	18.33 Bb	20.29 Ba
	5	39.20 Aa	40.69 Aa	19.68 Ab	21.41 Aa

¹Days after sprouting (DAS). 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 *B. tuldooides* fertilized with 5 kg ha⁻¹ of Zn. On the other hand, at 90 DAS without K fertilization and at 120 DAS with K fertilization of 80 kg ha⁻¹, the stem diameter of *B. tuldooides* 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 (Table 3). Some studies have shown that the maximum stem diameter was noted when plants of bamboo were fertilized with zinc, while minimum stem diameter was recorded in plants without fertilization, indicating differences up to 11% (BADSHAH; AYUB, 2013; BALDUINO JÚNIOR et al., 2016).

The internal stem diameter of *B. tuldooides* presented no differences when

fertilized with 0 and 80 kg ha⁻¹ of K at 120 DAS, regardless of the zinc rates, with the zinc rate of 5 kg ha⁻¹ at 60 DAS or without zinc fertilization at 90 DAS.

The K fertilization of 80 kg ha⁻¹ increased the internal stem diameter of *B. tuldooides* in 8.71% at 60 DAS, without Zn fertilization, in 17.11% at 90 DAS with Zn fertilization of 5 kg ha⁻¹. When comparing potassium rates of 0 and 80 kg ha⁻¹, at 150 DAS, in the Zn rates of 0 and 5 kg ha⁻¹, the internal stem diameter showed differences of 9.64% and 8.08%, respectively, in relation to the K rates. Bamboo is a species adapted to tropical climates; therefore, it has attracted attention in tropical countries due to its rapid growth (DRUMOND; WIEDMAN 2017), and according to Torqueti et al. (2016), the application of potassium doses influences this trait since it can provide significant increments, above 9%.

The internal stem diameter of *B. tuldooides* at 90 DAS showed no difference due to Zn rates (0 and 5 kg ha⁻¹), without K

fertilization. The highest internal stem diameter of *B. tuldoides* was found, in general, with a Zn rate of 5 kg ha⁻¹ regardless of the K fertilization.

Internal stem diameter presented increases of 13.71%, 6.82%, and 6.84% at 60, 120, and 150 DAS, respectively, as a result of the zinc rate of 5 kg ha⁻¹, without K fertilization; and differences of 9.54%, 16.72%, 9.08%, and 5.23% at 60, 90, 120, and 150 DAS, respectively, with K

fertilization of 80 kg ha⁻¹. Tahir et al. (2009) reported similar increasing trend for maize plants fertilized with zinc.

The number of internodes of *B. tuldoides* presented no differences when fertilized with 0 and 80 kg ha⁻¹ of K at 60 and 150 DAS regardless of the zinc rates, with the zinc rate of 5 kg ha⁻¹ at 90 DAS or without zinc fertilization at 120 DAS (Table 4).

Table 4. The number of internodes (NI) and stem circumference area (SCA) of *B. tuldoides* irrigated and fertilized with potassium and zinc.

DAS	Zn (kg ha ⁻¹)	K ¹ (kg ha ⁻¹)			
		NI		SCA (cm ²)	
		0	80	0	80
60	0	23.00 Aa	24.33 Aa	3.72 Ba	4.16 Ba
	5	23.67 Aa	24.00 Aa	5.92 Aa	6.44 Aa
90	0	24.67 Bb	29.00 Aa	6.15 Aa	5.92 Ba
	5	27.67 Aa	29.67 Aa	6.68 Aa	7.18 Aa
120	0	30.67 Aa	29.33 Ba	9.55 Bb	12.22 Aa
	5	32.67 Ab	35.00 Aa	12.01 Aa	12.41 Aa
150	0	39.33 Ba	39.67 Ba	10.87 Ba	11.67 Ba
	5	42.67 Aa	43.67 Aa	12.07 Ab	13.01 Aa

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

The K fertilization of 80 kg ha⁻¹ increased the number of internodes of *B. tuldoides* in 14.94% at 90 DAS without Zn fertilization and in 6.67% at 120 DAS with Zn fertilization of 5 kg ha⁻¹. Gomes et al. (2018) verified differences in sugarcane plants varying from 5.10% to 11.32% in the internode in a K fertilization of 80 kg ha⁻¹.

The number of internodes of *B. tuldoides* presented no differences when fertilized with 0 and 5 kg ha⁻¹ of Zn at 60 DAS regardless of the potassium rates, with the potassium rate of 80 kg ha⁻¹ at 90 DAS or without potassium fertilization at 120 DAS.

Number of internodes presented increases of 10.84% and 7.81% at 90 and 150 DAS, respectively, by cause of the zinc rate of 5 kg ha⁻¹, without K fertilization; and differences of 16.19% and 9.16% at 120 and

150 DAS, respectively, with K fertilization of 80 kg ha⁻¹. Silva et al. (2009) and Cunha et al. (2016) found that the growth parameters values, related to the number of culms, culm length, culm diameter, number of internodes and culm weight of sugarcane, responded significantly to irrigation and K fertilization.

The stem circumference area of *B. tuldoides* presented no differences when fertilized with 0 and 80 kg ha⁻¹ of K at 60 and 90 DAS regardless of the zinc rates, with the zinc rate of 5 kg ha⁻¹ at 120 DAS, no difference in stem circumference area was observed, whereas with the absence of zinc fertilization, it increased by 21.82% when applying 80 kg ha⁻¹ of K (Table 4). Sudradjat et al. (2018) stated that the application of K fertilizer increased the stem circumference by up to 23% compared to the control.

Potassium is the element with the greatest requirement and the highest content in the total biomass of bamboo; the K is also an element that can be temporarily stored in the culms (KLEINHENZ; MIDMORE, 2001; MENDES et al., 2010).

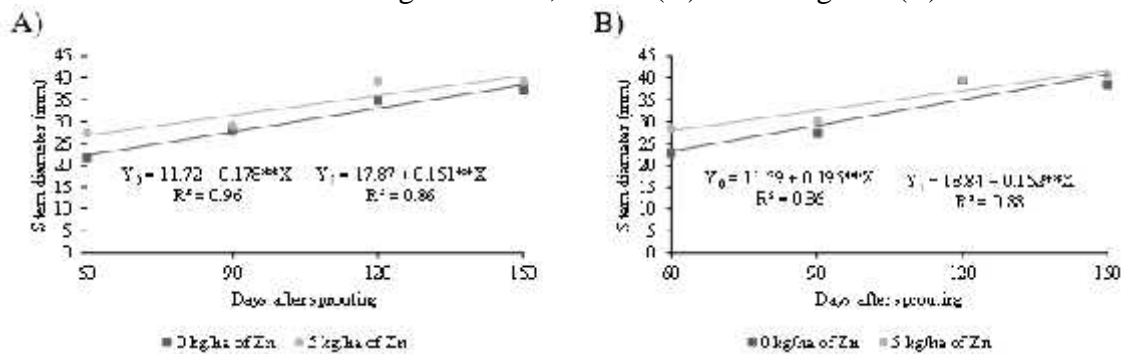
Bambusa tuldooides with the zinc rate of 5 kg ha⁻¹ at 150 DAS, fertilized with 80 kg ha⁻¹ of K, presented stem circumference area 7.20% higher than the stem circumference area found in the bamboo plants without potassium fertilization.

The highest stem circumference area was found in *B. tuldooides* fertilized with 5 kg

ha⁻¹ of Zn. Stem circumference area increased 37.19%, 20.51%, and 9.95% as a result of the 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 circumference area due to zinc rate of 5 kg ha⁻¹ were 35.38%, 17.64%, and 10.28% at 60, 90, and 150 DAS, respectively.

The stem diameter of *B. tuldooides* fitted to a linear model with mean R² of 89% (Figure 3) as a function of days after sprouting, regardless of the K and Zn fertilization.

Figure 3. The stem diameter of *B. tuldooides* irrigated 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.



** F value significant at 1% of probability

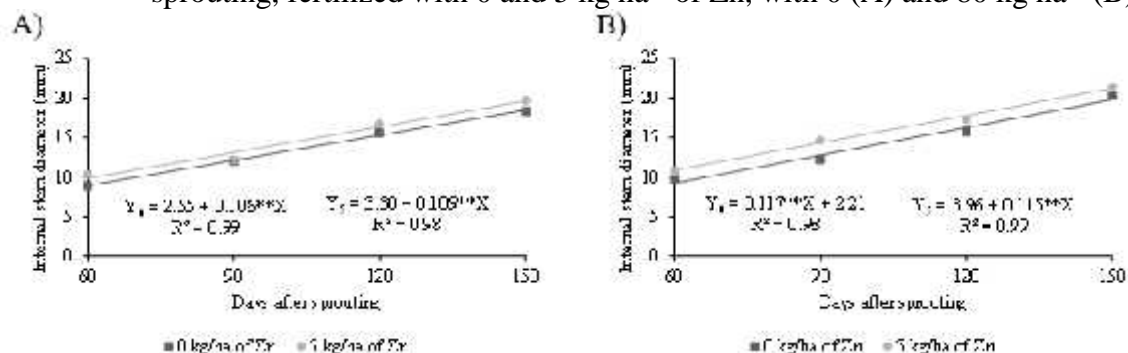
The regression equation showed increases in stem diameter of 13.90% and 11.17% every 30 days for Zn rates of 0 and 5 kg ha⁻¹, respectively, without K fertilization (Figure 3A), and increases of 14.33% and 10.96% every 30 days for Zn rates of 0 and 5 kg ha⁻¹, respectively, when using a K rate of 80 kg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

The stem diameter of *B. tuldooides* with K and Zn fertilization increased up to 150 DAS, where 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 dulloo* (24.7 mm) (AMLANI et al., 2017).

The internal stem diameter of *B. tuldooides* fitted to a linear model, with R² above 98% (Figure 4) as a function of days after sprouting, regardless of the K and Zn fertilization.

Figure 4. The internal stem diameter of *B. tuldooides* irrigated 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.



** F value significant at 1% of probability

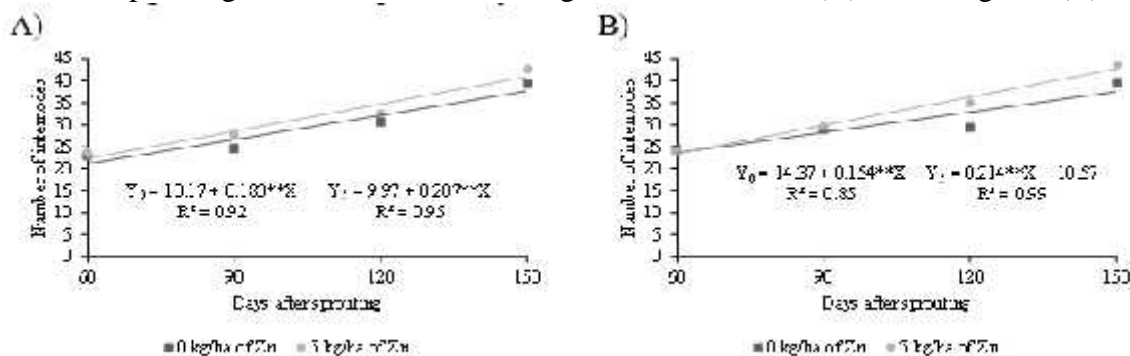
The internal stem diameter of *B. tuldooides* showed increases of 17.24 % and 16.63% every 30 days for Zn rates of 0 and 5 kg ha⁻¹, respectively, without K fertilization (Figure 4A), and increases of 17.76 and 16.26%, respectively, with a K rate of 80 kg ha⁻¹ (Figure 4B).

The internal stem diameter of *B. tuldooides* with K and Zn fertilization increased up to 150 DAS, where they reached the maximum internal stem

diameter, approximately 21.21 mm. Regarding the distribution of diameter classes of Moso bamboo, it is evident that there is a steady increase in diameter classes 0~20 and 21~40 mm over time (CHEN et al., 2016).

The number of internodes of *B. tuldooides* fitted to a linear model with mean R² of 92.75% (Figure 5) as a function of days after sprouting, regardless of the K and Zn fertilization.

Figure 5. The number of internodes of *B. tuldooides* irrigated 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.



** F value significant at 1% of probability

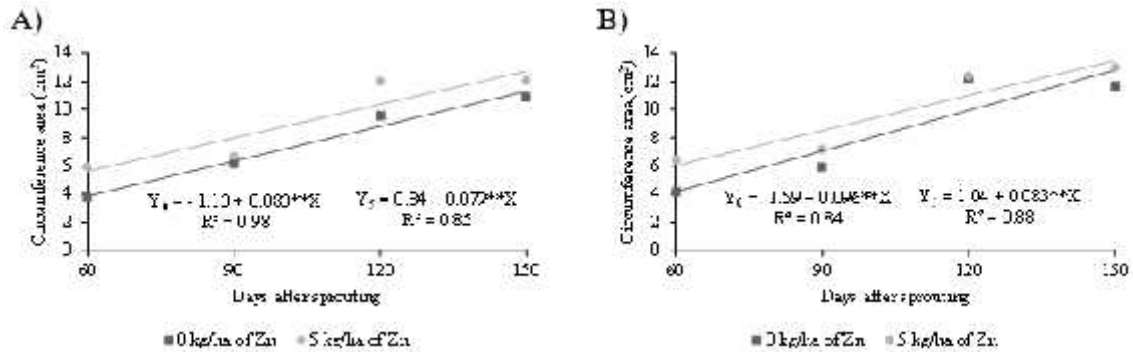
The regression equation showed increases in number of internodes of 14.60% and 15.13% every 30 days for Zn rates of 0 and 5 kg ha⁻¹, respectively, without K fertilization (Figure 5A). Increases of 12.34 % and 15.05% every 30 days for Zn rates of 0 and 5 kg ha⁻¹, respectively, were registered when using a K rate of 80 kg ha⁻¹ (Figure 5B).

Bamboo is among the fastest growing plants because the internodal growth occurs at the growth zone in all internode, and thus, the elongation growth of bamboo culm is quite rapid during its growing season (TOBA et al., 2016).

The stem circumference area of *B. tuldooides* fitted to a linear model with mean R² of 88.75% (Figure 6) as a function of days

after sprouting, regardless of the K and Zn fertilization.

Figure 6. The stem circumference area of *B. tuldoides* irrigated 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.



** F value significant at 1% of probability

The stem circumference area of *B. tuldoides* showed increases of 21.99% and 18.67% every 30 days for Zn rates of 0 and 5 kg ha⁻¹, respectively, without K fertilization (Figure 6A), and increases of 22.50 and 18.47%, respectively, with a K rate of 80 kg ha⁻¹ (Figure 6B). Chaab et al. (2011) highlights that the favorable effect of zinc fertilization, on growth attributes, may be ascribed to its stimulatory effect on most of the physiological and metabolic processes of plant cells.

6 CONCLUSIONS

The fertilization with potassium rates and zinc influences the growth and development of *Bambusa tuldoides* irrigated, promoting increases in most of the analyzed variables.

The growth of *B. tuldoides* irrigated is maximized when fertilized with 80 kg ha⁻¹ of K and 5 kg ha⁻¹ of Zn.

Bambusa tuldoides irrigated and fertilized with 80 kg ha⁻¹ of K presented internode length 5.77% higher than the internode length found in the plant group without potassium fertilization.

The internode length of the *B. tuldoides* irrigated and without Zn

fertilization was 4.82% lower than that with Zn rate of 5 kg ha⁻¹.

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