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Original Article

Response to the application of thidiazuron on winter bean cultivated in an Oxisol from Savannah[1]

Resposta à aplicação do thidiazuron no feijão de inverno cultivado em Latossolo do Cerrado

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HIGHLIGHTS:

The plant growth regulator thidiazuron resulted in greater nitrogen accumulation.
IAC Sintonia was the common bean cultivar that responded best to the plant growth regulator.
The climatic conditions may influence the efficiency of the plant growth regulator.

ABSTRACT: Common bean (*Phaseolus vulgaris* L.) plays a significant socio-economic role in Brazil. The application of management tools in agriculture, including plant growth regulators, can enhance productivity while also benefiting the environment and the economy. The objective of this study was to evaluate the effects of foliar application of the plant growth regulator thidiazuron, at doses and application times, on production components and foliar nitrogen (N) concentration in bean. The experiment was conducted over two agricultural years at an experimental station located in the municipality of Selvíria, state of Mato Grosso do Sul, Brazil. The experimental design used was a randomized block design with a 4 × 3 factorial scheme, consisting of four doses of thidiazuron (0, 1, 2, and 3 g ha^{-1}) applied at three growth stages, on the first trifoliate leaf (V_3), on the third trifoliate leaf (V_{4-5}) and at pre-flowering (R_5). The soil of the area was classified as an Oxisol. The cultivars planted were BRS Estilo and IAC Sintonia in the first year and IPR Campos Gerais in the second year. The productivity of the cultivars IAC Sintonia and BRS Estilo increased with application doses up to 1.62 and 2.34 g ha^{-1} of thidiazuron, respectively. The dose of 1.82 g ha^{-1} of the growth regulator increased N content in BRS Estilo and there was greater N accumulation in the V_{4-5} stage of IAC Sintonia. The application of thidiazuron increased the productivity of the IAC Sintonia and BRS Estilo regardless of the application timing.

Key words: *Phaseolus vulgaris* L., plant growth regulator, productivity, nitrogen, physiological response

RESUMO: O feijão-comum (*Phaseolus vulgaris* L.) desempenha um papel socioeconômico significativo no Brasil. O uso de ferramentas de manejo aplicadas à agricultura, incluindo reguladores de crescimento de plantas, pode aumentar a produtividade e contribuir ambiental e economicamente. O objetivo deste estudo foi avaliar os efeitos da aplicação foliar do regulador de crescimento thidiazuron, em diferentes doses e épocas, sobre os componentes de produção e a concentração de nitrogênio (N) nas folhas do feijão. O experimento foi conduzido ao longo de dois anos agrícolas, em uma estação experimental localizada no município de Selvíria, estado de Mato Grosso do Sul, Brasil. O delineamento experimental utilizado foi o de blocos ao acaso, com um esquema fatorial 4 × 3, consistindo em quatro doses de thidiazuron (0, 1, 2 e 3 g ha^{-1}) aplicadas em três estádios de crescimento: na primeira folha trifoliolada (V_3), na terceira folha trifoliolada (V_{4-5}) e na pré-floração (R_5). O solo da área foi classificado como Latossolo, e as cultivares utilizadas foram BRS Estilo e IAC Sintonia no primeiro ano e IPR Campos Gerais no segundo. A produtividade das cultivares IAC Sintonia e BRS Estilo aumentou com as doses de 1,62 e 2,34 g ha^{-1} de thidiazuron, respectivamente. A dose de 1,82 g ha^{-1} do regulador de crescimento aumentou o conteúdo de N na cultivar BRS Estilo, e houve maior acúmulo de N no estágio V_{4-5} da IAC Sintonia. A aplicação de thidiazuron aumentou a produtividade da IAC Sintonia e BRS Estilo independentemente da época de aplicação.

Palavras-chave: *Phaseolus vulgaris* L., regulador vegetal, produtividade, nitrogênio, resposta fisiológica

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Introduction

Common bean (*Phaseolus vulgaris* L.) is a staple food in the Brazilian diet, serving as an essential source of plant protein, as well as carbohydrates, vitamins, minerals and fiber. According to Wander & Silva (2023), the average annual per capita consumption is 12.2 kg per inhabitant and approximately 90% of the production is destined for the domestic market. Brazil is the second-largest producer of this legume in the world, with the Southern region being the largest national producer (Coêlho, 2023). The productive potential of common bean can exceed 3,000 kg ha^{-1}, provided that climatic and management conditions are adequate (EMBRAPA, 2023).

Common bean can be cultivated in three seasons of the year, with the first sowing between October and November (rainy season), the second from February to March (dry season), and the third between May and July (winter season). Due to its short cycle (80 to 120 days) and the fact that most of its root system is concentrated in the first centimeters of the soil, common bean becomes highly demanding in terms of soil quality (Carvalho & Siqueira, 2023). Additionally, it is susceptible to various pests and diseases, resulting in damage that can lead to crop losses of up to 100% (Quintela, 2021).

In this context, the use of plant growth regulators can represent an interesting alternative to increase production. Thidiazuron (TDZ - N-phenyl-N'-1,2,3-thiadiazol-5-ylurea) was developed to be a defoliant for cotton (Arndt et al., 1976). However, it was observed that, at lower concentrations, TDZ exhibits activity analogous to cytokinin (Mok et al., 1982). In general, cytokinins are associated with cell division, lateral root growth, delayed senescence, regulation of cell differentiation and improved nitrogen (N) uptake (Coll et al., 2001; Taiz et al., 2017). Srivastava et al. (1994) found that cytokinin not only accelerates nitrate (NO_3^-) uptake but also prevents damage caused by its excess in tissues, making it a valuable tool for optimizing N use efficiency in certain crops.

When compared to other synthetic cytokinins, such as benzyladenine and kinetin, TDZ has greater resistance to the action of oxidases, allowing greater stability of the molecule and, consequently, longer-lasting regulatory activity. Therefore, it can be supplied in smaller doses and applied less frequently, reducing costs (Mok et al., 1987). TDZ is widely used in fruit growing as a synthetic cytokinin for fruit thinning and induction of lateral buds. However, it has promoted increases in the productivity of other crops, such as rice and sugarcane (Silva, 2010; Alves et al., 2015).

Thus, the application of TDZ in common bean can provide an increase in production, as well as influence nitrogen accumulation in tissues, due to its effect analogous to cytokinin. Based on the above, the objective of this study was to evaluate the effect of the plant growth regulator thidiazuron, applied at different times and doses, on production components and productivity, as well as foliar nitrogen content in common bean cultivars.

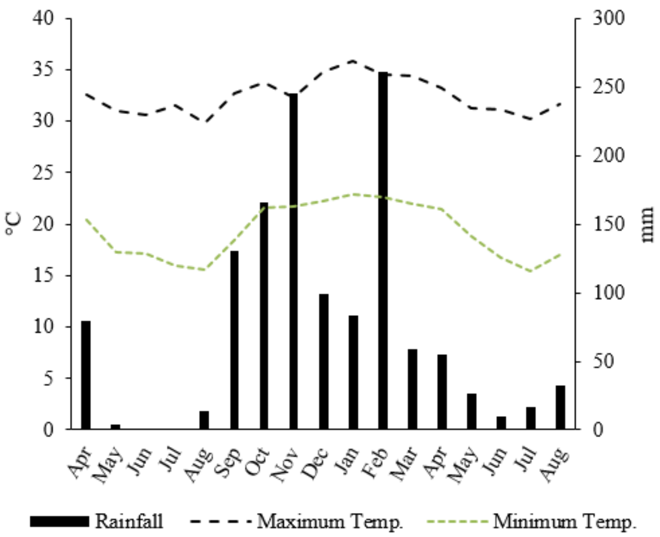
Material and Methods

The experiment was conducted in an experimental area belonging to the Faculty of Engineering - UNESP, Ilha Solteira Campus, located in the municipality of Selvíria (MS), with geographic coordinates 51° 22' West longitude and 20° 22' South latitude, at an altitude of 335 m. The soil in the area is classified as an Oxisol (United States Department of Agriculture - USDA, 1999) with a clay content of 50%.

For soil sampling, simple random samples were collected at 20 points within the experimental area at a depth of 0 to 0.20 m. These samples were homogenized and analyzed. The chemical characteristics of the soil were determined before the experiments were set up, following the methodology proposed by Raij et al. (2001) and are presented in Table 1.

The region's climate is classified as Aw according to the Köppen classification, with an average annual temperature of 23 °C and an average annual rainfall of 1.322 mm (Alvares et al., 2013). Figure 1 shows the distribution of rainfall and maximum and minimum temperatures during the experimental period.

Three individual experiments were established, over two agricultural years (2018 and 2019), with three cultivars: BRS Estilo and IAC Sintonia in the first year, and IPR Campos Gerais in the second year. The cultivars are characterized as type II plants, with indeterminate growth, bushy architecture, erect and closed branching, pods that do not touch the soil and carioca-type grains.



Source: Canal Clima, UNESP Ilha Solteira

Figure 1. Climatic data for the experimental crop during the period April23, 2018 to August, 2019

Table 1. Chemical analysis of soil (0 - 0.20 m), before the experiments were set up

pH	OM	$S\text{-}SO_4^{2-}$	P	K	Ca	Mg	H+Al	Al	SB	CEC	V	B	Cu	Fe	Mn	Zn
$CaCl_2$	(g dm^{-3})	(mg dm^{-3})		(mmol$_c$ dm^{-3})							(%)	(mg dm^{-3})				
5.5	22	6	22	4.4	26	20	25	0	50.4	75.4	67	0.15	5.1	16	57.6	0.9

OM - Organic matter; $S\text{-}SO_4^{2-}$ - Extractable sulfur; P - Phosphorus; K - Potassium; Ca - Calcium; Mg - Magnesium; H+Al - Hydrogen + Aluminum (exchangeable acidity); SB - Sum of bases; CEC - Cation exchange capacity; V% - Base saturation; B - Boron; Cu - Copper; Fe - Iron; Mn - Manganese; Zn - Zinc. Extraction methods - P - Resin; B - Hot water; Cu, Fe, Mn, and Zn – DTPA

Mechanical seeding was carried out with a row spacing of 0.45 m on April 23, 2018, May 8, 2018, and April 30, 2019, for BRS Estilo, IAC Sintonia and IPR Campos Gerais, respectively. The desired population was approximately 200,000 plants ha^{-1}. Seeds were treated with piraclostrobin, thiophanate-methyl and fipronil, at rates of 5, 45, and 50 g a.i. 100kg^{-1} of seeds, respectively.

Inoculation was performed with *Rhizobium tropici* and *Azospirillum brasilense* using 200 mL of each inoculant for every 25 kg of seeds. The inoculant containing *R. tropici* consisted of 3 × 10^{9} colony-forming units (CFU) mL^{-1} of strains SEMIA 4077 and 4088, while that of *A. brasilense* contained 2 × 10^{8} CFU mL^{-1} of strains Ab-V5 and Ab-V6. Inoculation was carried out after chemical treatment and drying of the products on the seeds. The inoculation operation was performed in the shade, shortly before sowing, manually, using plastic bags to facilitate mixing the inoculants with the seeds.

The experimental design adopted was a randomized complete block design, arranged in a 4 × 3 factorial scheme, with four replications, being four doses of TDZ (0, 1, 2, and 3 g ha^{-1}) and three application times. The application times were: at the first trifoliate leaf (V_3), third trifoliate leaf (V_{4-5}) and at pre-flowering (R_5) (Fernandez et al., 1986). Each plot consisted of seven rows, six meters long and the central five rows were considered the observation area of each plot.

Mineral fertilization was applied in the seed furrow at a rate of 250 kg ha^{-1} using an 08-28-16 formulation for all three cultivars. The rate was calculated based on soil chemical characteristics (Table 1) and recommendations by Raij et al. (1996). Topdressing with N was applied at the V_{4-5} growth stage (Fernandez et al., 1986) for all cultivars. Urea was used as the N source at a rate of 90 kg N ha^{-1}. After application, irrigation was initiated to minimize N volatilization losses. For the IAC Sintonia cultivar, N fertilization was split into two applications. The first application was on May 28, 2018, using ammonium sulfate at a rate of 40 kg N ha^{-1}. The second application was on June 11, 2018, using urea at a rate of 50 kg N ha^{-1}.

Plant growth regulator was applied to the foliage using a manual backpack sprayer equipped with a cone nozzle, operated at maximum allowable pressure and a spray volume of 180 L ha^{-1}. The product was diluted with 99% absolute alcohol and the sprayer was calibrated according to the TDZ concentration.

Weed, pest and disease control was performed using herbicides, insecticides, and fungicides registered for the crop. Irrigation management followed the recommendations of Doorenbos & Kassam (1988), using crop coefficients (Kc) of 0.30 for the V_0-V_2 growth stage, 0.70 for V_3-V_4, 1.05 for R_5-R_7, 0.75 for R_8 and 0.25 for R_9.

The following assessments were performed:

Aboveground dry matter (ADM): six plants were collected from the observation area of each plot at full flowering (R_5) stage. These plants were dried in a forced-air oven at 65 °C for 72 hours. Subsequently, the samples were weighed and the values were converted to grams per plant.

Leaf nitrogen: 20 trifoliates were collected from each plot at the R_6 phenological stage and dried in a forced-air oven at 65 °C for 72 hours. Subsequently, they were ground in a Wiley mill. N was determined according to Malavolta et al. (1997), using open sulfuric acid digestion and the semi-micro Kjeldahl method.

Number of pods per plant: the number of pods per plant was determined by counting the pods on a sample of eight plants collected from each plot.

Number of grains per plant: the number of grains per plant was determined by counting the grains on a sample of eight plants collected from each plot.

Number of grains per pod: the number of grains per pod was calculated by dividing the number of grains by the number of pods, considering a sample of eight plants from each plot.

100-Grain weight: two samples of 100 grains were collected from each plot and weighed on a precision balance. The moisture content was adjusted to 13% (wet basis).

Grain yield: all plants from the observation area of each plot were harvested, sun-dried and mechanically threshed. The grains were then weighed, and the data was converted to kg ha^{-1} (13% wet basis).

Data were subjected to analysis of variance and means were compared using Tukey's test ($p \leq 0.05$). For TDZ doses, regression analysis was performed according to Pimentel-Gomes & Garcia (2002). Statistical analyses were performed using the statistical analysis program SISVAR (Ferreira, 2000).

Results and Discussion

There was no significant interaction effect between doses and application times for the three cultivars regarding ADM and foliar N content (Table 2). However, IAC Sintonia accumulated significantly more ADM at stages V_3 and R_5 (Table 2). According to Taiz et al. (2017), cytokinins, when supplied at adequate doses, promote cell expansion, lateral bud outgrowth and nutrient mobilization, establishing sinks that become a priority for plants. Conversely, IAC Sintonia showed lower foliar N content at V_3 and R_5, with the highest value at stage V_{4-5}, likely due to a dilution effect (Marschner, 2012).

Leaf N content was higher in BRS Estilo with the application of TDZ (Table 2), with a quadratic adjustment with a maximum point at a dose of 1.82 g ha^{-1} of the product (Figure 2).

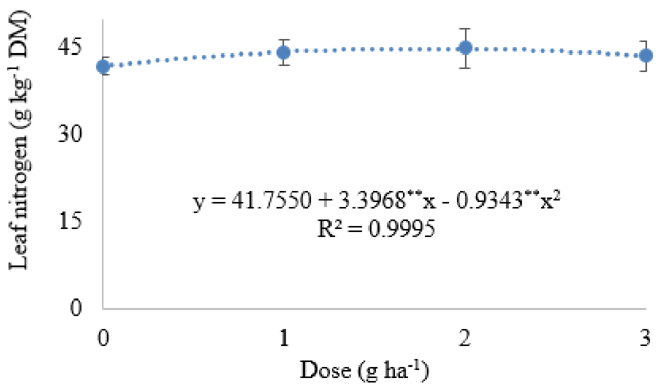
The fact that the BRS Estilo cultivar was responsive to TDZ, with higher N accumulation, may be related to the role played by cytokinins in the metabolism of this macronutrient. According to Coutinho Neto et al. (2023), cytokinins are activators of nitrate reductase, an enzyme responsible for the assimilatory reduction of NO_3^-, characterized as an essential step for the incorporation of N into amino acids.

Cytokinins are also related to photosynthesis, as the proteins that make up the antenna complex, which is responsible for light capture, are synthesized in response to this phytohormone. In addition, they have a role in the transcription of genes that encode the subunits of ribulose 1,5-bisphosphate carboxylase/oxygenase (RuBisCO), an enzyme crucial for carbon (C) fixation in the Calvin cycle. Cell division and the development of new photosynthetic tissues, promoted by cytokinin, increase the synthesis of RuBisCO in these locations, thereby improving photosynthetic efficiency

Table 2. Summary of F-test, aboveground dry matter (ADM), and leaf nitrogen content of BRS Estilo, IAC Sintonia, and IPR Campos Gerais under different thidiazuron treatments

T	BRS Estilo	IAC Sintonia	IPR Campos Gerais	BRS Estilo	IAC Sintonia	IPR Campos Gerais
	ADM (g per plant)			Leaf Nitrogen (g kg^{-1})		
Stage						
V_3	14.9	15.8 a	14.0	44.3	43.6 ab	50.2
V_{4-5}	15.2	13.5 b	14.5	43.7	46.4 a	50.6
R_5	15.2	15.7 a	13.3	42.6	43.4 b	48.3
Doses (g ha^{-1})						
0	14.4	14.3	11.9	41.7	45.1	52.0
1	16.2	15.6	15.0	44.1	43.4	48.3
2	15.7	14.4	14.4	44.8	45.3	47.8
3	14.1	15.7	14.4	43.5	44.1	50.6
F-test						
Stage (S)	0.02^{ns}	7.96**	0.42^{ns}	2.68^{ns}	4.03*	1.02^{ns}
Doses (D)	0.98^{ns}	2.00^{ns}	1.93^{ns}	4.66*	0.83^{ns}	1.98^{ns}
S × D	0.16^{ns}	2.45^{ns}	0.92^{ns}	0.60^{ns}	1.40^{ns}	0.31^{ns}
CV (%)	20.26	10.8	21.82	4.22	6.55	9.76

*, **, and ns indicate significance at the 5 and 1% levels, and not significant by F test, respectively. Means followed by the same letter are not significantly different (Tukey test, $p \leq 0.05$). T - Treatment; CV - Coefficient of variation



The vertical bars represent the standard deviation (n = 4). ** - Significant at $p \leq 0.01$ by the F test. Coefficient of variation: 4.22%

Figure 2. Relationship between thidiazuron doses and leaf nitrogen content in dry matter (DM) of the BRS Estilo cultivar

and, consequently, potentially increasing plant productivity (Fagan et al., 2015; Taiz et al., 2017).

There was no significant interaction between the application times and the doses for the number of pods per plant, grains per plant and grains per pod for the three cultivars (Table 3). However, for TDZ doses, a positive response was observed in the number of pods and grains per plant of IAC Sintonia (Table 3).

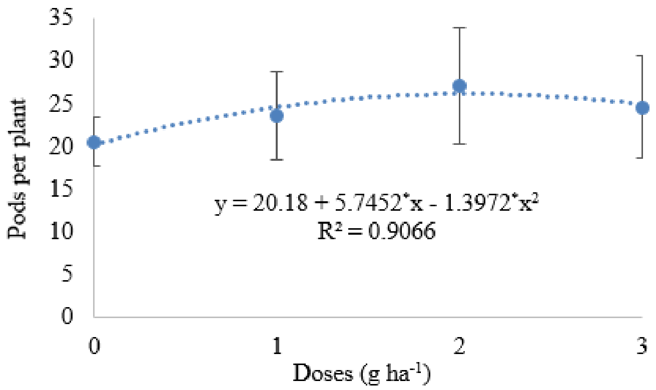
There was a quadratic adjustment for IAC Sintonia, where the dose of 2.26 g ha^{-1} of TDZ was the maximum point for the increase in pods per plant (Figure 3). Moreira & Soares (2019), in a similar study, reported a 35% increase in the number of soybean pods with foliar application of kinetin. According to these authors, cytokinin reduces flower abortion, resulting in a higher number of pods, which can lead to an increase in grain yield and productivity.

There was a quadratic adjustment for the number of grains per plant in relation to TDZ doses for IAC Sintonia, and the derivation of the equation shows the maximum point at the dose of 2.32 g ha^{-1} (Figure 4). This result is attributed to the cytokinin effect of increasing the number of fertilized flowers, which elevates the number of grains per plant. However, the increase in the number of pods and grains per plant typically decreases the number of grains per pod (Nagel et al., 2001; Guimarães et al., 2021).

Table 3. Summary of F-test and mean values of number of pods per plant, grains per plant, and grains per pod for BRS Estilo, IAC Sintonia, and IPR Campos Gerais cultivars as a function of planting date and thidiazuron dose

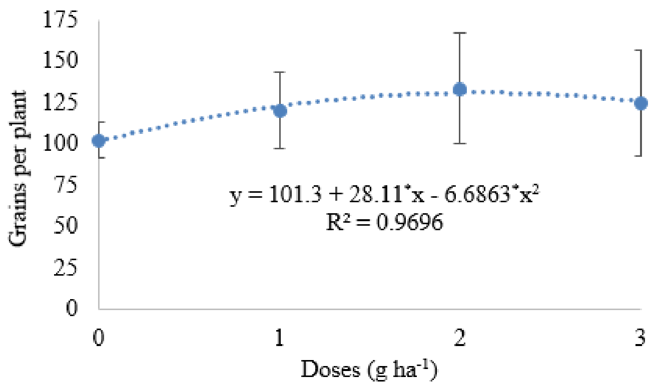
T	BRS Estilo	IAC Sintonia	IPR Campos Gerais	BRS Estilo	IAC Sintonia	IPR Campos Gerais	BRS Estilo	IAC Sintonia	IPR Campos Gerais
	Pods per plant			Grains per plant			Grains per pod		
Stage									
V_3	19	24	26	97	120	153	5.0	5.0	6.0
V_{4-5}	18	23	26	88	115	143	5.0	5.0	6.0
R_5	18	25	24	92	125	143	5.0	5.0	6.0
Doses (g ha^{-1})									
0	19	20	29	93	102	176	5.0	5.0	6.0
1	17	24	22	87	120	136	5.0	5.0	6.0
2	19	27	24	92	133	127	5.0	5.0	5.0
3	19	24	26	99	124	146	5.0	5.0	5.0
F test									
Stage (S)	7.41^{ns}	0.66^{ns}	0.29^{ns}	0.92^{ns}	0.62^{ns}	0.26^{ns}	0.63^{ns}	0.75^{ns}	0.64^{ns}
Doses (D)	18.42^{ns}	2.98^{*}	1.82^{ns}	0.88^{ns}	3.26^{*}	2.60^{ns}	0.79^{ns}	0.88^{ns}	4.41^{**}
S × D	4.29^{ns}	0.85^{ns}	0.38^{ns}	0.67^{ns}	1.21^{ns}	0.34^{ns}	0.43^{ns}	1.35^{ns}	0.98^{ns}
CV (%)	18.56	22.67	30.56	19.61	21.00	31.40	6.25	4.86	9.02

*, **, and ns indicate significance at the 5 and 1% levels, and not significant by F test, respectively. T - Treatment; CV - Coefficient of variation



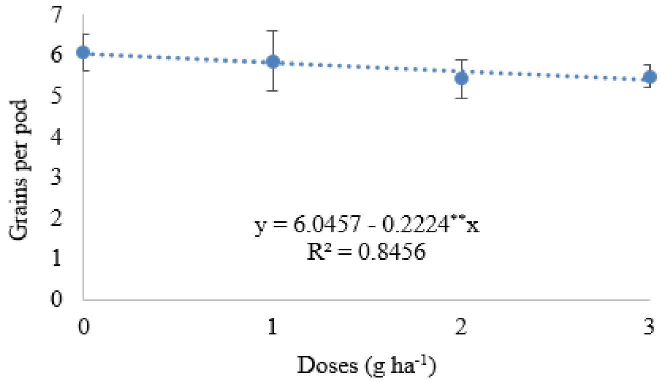
The vertical bars represent the standard deviation (n = 4). ns and * - not significant and significant at $p \leq 0.05$ by the F test. Coefficient of variation: 22.67%

Figure 3. Relationship between thidiazuron doses and number of pods per plant for the IAC Sintonia cultivar



The vertical bars represent the standard deviation (n = 4). ns and * - not significant and significant at $p \leq 0.05$ by the F test. Coefficient of variation: 21.00%

Figure 4. Relationship between thidiazuron doses and number of grains per plant for the IAC Sintonia cultivar



The vertical bars represent the standard deviation (n = 4). ** - Significant at $p \leq 0.01$ by the F test. Coefficient of variation: 9.02%

Figure 5. Relationship between thidiazuron doses and number of grains per pod for the IPR Campos Gerais cultivar

For IPR Campos Gerais, a negative linear adjustment was observed for the number of grains per pod, with a reduction of 11.04% (Figure 5). The different responses among cultivars may be related to the genetic characteristics of each cultivar, as well as climatic and management conditions. Martins et al. (2013) found different responses among melon cultivars using a product analogous to cytokinin. However, Fernandes et al. (2020) reported no significant increase in the number of oat tillers in response to the application of TDZ doses. The authors explain that the chosen doses and application times were not suitable to favor crop performance.

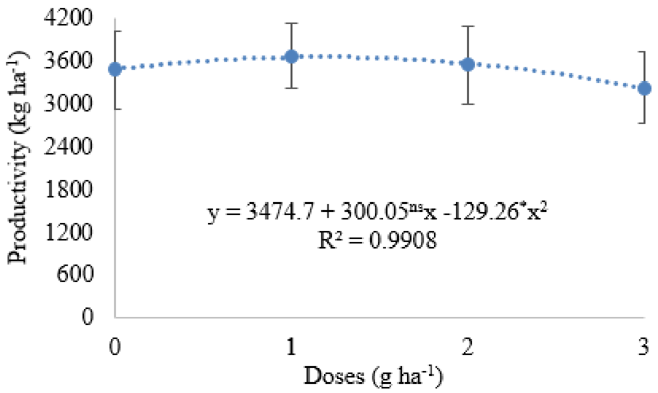
Mean values and summary of the F-test for 100-grain weight and grain yield are presented in Table 4. There was no interaction effect between application times and doses; however, doses influenced these attributes. For 100-grain weight, TDZ doses had a negative effect on the IPR Campos Gerais cultivar, although this did not impact its yield (Table 4). Passos et al. (2008) obtained different results, observing an increase in soybean 100-grain weight with TDZ application. They attributed this effect to increased production and better redistribution of photoassimilates to pods and seeds, caused by elevated endogenous cytokinin levels. IAC Sintonia and BRS Estilo cultivars showed positive responses to TDZ application in terms of yield (Table 4).

Maximum productivity was observed at 1.62 g ha^{-1} TDZ for BRS Estilo (Figure 6). For IAC Sintonia, maximum productivity was achieved at 2.34 g ha^{-1} TDZ, with regression equation $y = 3323.9 + 501.45x - 107.25x^2$ ($R^2 = 0.5673$). Similar results were found by Alves et al. (2015) in rice, where TDZ application also increased yield. This increase in yield is likely due to the relationship between cytokinin and N uptake and utilization efficiency.

Table 4. Mean values of 100-grain weight and grain yield for BRS Estilo and IAC Sintonia cultivars as a function of planting date and thidiazuron dose

T	BRS Estilo	IAC Sintonia	IPR Campos Gerais	BRS Estilo	IAC Sintonia	IPR Campos Gerais
	100-grain weight (g)			Grain yield (kg ha^{-1})		
Stage						
V_3	30	29	25	3513	3791	4387
V_{4-5}	31	28	26	3473	3647	4421
R_5	30	28	25	3432	3664	4472
Doses (g ha^{-1})						
0	31	28	26	3468	3235	4685
1	31	28	25	3667	3985	4152
2	30	29	24	3537	3631	4387
3	30	29	25	3219	3952	4482
F-test						
Stage (S)	0.08^{ns}	0.91^{ns}	1.89^{ns}	0.17^{ns}	0.32^{ns}	0.05^{ns}
Doses (D)	0.12^{ns}	0.94^{ns}	0.82^{**}	2.85^{*}	4.83^{**}	0.99^{ns}
S × D	0.28^{ns}	2.04^{ns}	0.46^{ns}	0.31^{ns}	0.70^{ns}	0.05^{ns}
CV (%)	4.52	2.75	3.8	11.12	12.87	17.34

*, **, and ns indicate significance at the 5% and 1% levels, and not-significant by F test, respectively. T - Treatment; CV - Coefficient of variation



The vertical bars represent the standard deviation (n = 4). ns and * - not significant and significant at $p \leq 0.05$ by the F test. Coefficient of variation: 11.12%

Figure 6. Relationship between productivity and thidiazuron doses for BRS Estilo

Like cytokinins, N is directly involved in photosynthesis, being a constituent of chlorophyll. Additionally, it is part of carbohydrates and proteins, playing a crucial role in plant growth and yield. Cytokinins also affect plastid development, which is a site of photosynthesis, the storage of substances like proteins and starch, and the synthesis of amino acids and fatty acids. These effects impact productivity, as reported by Soares et al. (2017), with increased N content, dry matter accumulation and yield gains in soybean with kinetin application.

Distinct edaphoclimatic conditions can account for the varying responses among cultivars. A comparison between the results obtained by Alves et al. (2015) and Buzo et al. (2018), who worked with the same cultivar but in different years, showed discrepant results, which may be attributed to the specific edaphoclimatic conditions of each year.

For all analyzed attributes, there was no influence of the TDZ application time; thus, the product can be applied from the V_3 to the R_5 stage. There are few studies in the literature involving TDZ in grain crops; therefore, more studies are needed that examine doses, application methods, cultivars, and different edaphoclimatic conditions, as well as the influence of TDZ on other attributes, such as plant physiology and nutrient accumulation in tissues and grains.

Conclusions

1. The number of pods and grains per plant increased in the IAC Sintonia cultivar with the application of thidiazuron.

2. The application of thidiazuron in the 'winter' bean crop at rates of 1.62 and 2.34 g ha^{-1} resulted in increased grain yield of the cultivars IAC Sintonia and BRS Estilo, respectively, regardless of the application timing (from V3 to R5 stages).

3. For the IPR Campos Gerais cultivar, the application of thidiazuron reduced the 100-grain weight and did not increase grain yield.

4. There was no effect of thidiazuron application on aboveground dry matter or the number of grains per pod in the three tested cultivars.

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