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Trichoderma AS A GROWTH PROMOTER IN *Myracrodruon urundeuva* Fr. All.

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Abstract: Fungi of the genus Trichoderma are microorganisms capable of enhancing plant growth. These fungi can positively influence the initial growth of *Myracrodruon urundeuva* Fr. All. (aroeira do sertão), forest species of great economic value. Thus, the objective of this work was to evaluate the efficiency of the inoculation of five Trichoderma isolates, as plant growth promoters with and without phosphorus fertilization in the mastic culture, in a greenhouse, using Cerrado soil as substrate. Two independent experiments were carried out, one with natural phosphate fertilization and the other without fertilization, both inoculated with Trichoderma. Two evaluations were carried out, the first carried out 50 days after sowing (DAS) and the other at 100 DAS. Morphological characteristics such as height, root length, stem diameter, shoot dry mass, root dry mass and total dry mass were evaluated. Dickson's quality index and relative efficiency were also evaluated. For individuals fertilized with natural phosphate there was variation in growth promotion from 25.4 to 925% in relation to the control. The experiment without fertilization showed variation from 26.5 to 425.4% in growth in relation to the control. The results demonstrate the ability of *Trichoderma* isolates to promote the initial growth of *Myracrodruon urundeuva Fr. All.* fertilized or not with natural phosphate.
Keywords: Forest seedlings. Biostimulant. Native tree.

INTRODUCTION

According to the MapBiomas Annual Deforestation Report (RAD), Brazil lost 1,655,782 ha of native vegetation cover in all its biomes in 2020, an increase of 20% compared to 2019 (MAPBIOMAS, 2021).

MapBiomas' Annual Deforestation Report (RAD) refined and validated 69,796 deforestation alerts in 2021 throughout the national territory. The Amazon biome

concentrated 59% of the deforested area and 66.8% of the deforestation alerts in 2021, and the Cerrado with 30%, representing just over half a million hectares (MAPBIOMAS, 2021).

The cerrado biome occupies a quarter of the Brazilian territory, with an area of 212 million hectares, and is present in the states of Maranhão, Piauí, Ceará, Bahia, Minas Gerais, Tocantins, Goiás, Distrito Federal, Mato Grosso, Mato Grosso do Sul , São Paulo and Paraná. Its preservation is extremely important because it has a great diversity of fauna and flora species and also because it provides important environmental services (WWF, 2019).

From an environmental and forest standpoint, there is more extraction of native trees than replacement in all Brazilian biomes. One way to mitigate deforestation will be the implementation of policies aimed at recovering degraded areas with the planting of native species and forest replacement programs. The production of seedlings of native plants via seed is the most indicated way, as it is economically low cost and ensures the genetic variability of the populations (SANTARELLI, 2004).

In order to reduce expenses in seedling nurseries of native species, the subsoil is used as substrate, but this practice can present low seedling yield due to the low fertility of this substrate (MACEDO, 1983).

Forest stands in Brazil have been implanted where soils have a low level of macro nutrients, mainly phosphorus. Phosphorus (P) is one of the macro nutrients that limits plant growth, as it plays an important role in the production of energy (ATP), DNA and RNA (TAIZ & ZEIGER, 2004). The concentration of soluble P is low in soils, up to 20% of this soluble P is available to the plant, the remainder becomes unavailable due to adsorption, precipitation or organic conversion (HOLFORD, 1997).

The species *Myracrodruon urundeuva* FR. All (aroeira do sertão) belongs to the Anacardiaceae family, having a wide geographic distribution in the Americas, with a natural distribution in South America, and can be found in vegetation formations of caatinga, Cerrado and rain forest, with the size varying according to the place of occurrence, reaching 30 m in height (LORENZI, 1992). It was heavily exploited due to its heavy, compact and rot-resistant wood (RIZZINI, 1987). It entered the list of endangered species in Brazil, presenting a high risk of disappearing from nature in the future (IBAMA, 2008).

Slow growth is one of the biggest problems encountered in the production of seedlings of native forest species. Myracrodruon urundeuva FR. All is classified as a late or climax species (LORENZI, 1992). In this context, it appears that the use of microorganisms such as Trichoderma spp. can contribute to plant growth (KLEIFELD & CHET, 1992), as it improves nutrient absorption and efficient use of fertilizer (HARMAN, 2001; SHERAMETI et al., 2005), in addition to reducing input costs, being excellent nutrient solubilizers (ALTOMARE et al., 1999).

Fungi belonging to the genus *Trichoderma* colonize the rhizosphere and are free-living, being one of the most studied fungi due to its plant growth promoting activity and phytopathogen biocontrol agent (HOHMANN et al., 2011). This fungus has the ability to promote plant growth of up to 300% (BROTMAN et al., 2010).

The use of *Trichoderma* provides a wide range of benefits to the plant, significantly increases seed germination (SRIVASTAVA et al., 2010); greater growth, greater dry weight of root and shoot, increases lateral roots (CARVALHO FILHO et al., 2008; CONTRERAS-CORNEJO et al., 2009); increases resistance to water stress, salt and high temperatures (WALLER et al., 2005; GAMALERO et al., 2009); acts in biological

control with parasitism, hyperparasitism, mycoparasitism and promotes systemic resistance to diseases (HARMAN et al., 2004; WALLER et al., 2005); synthesis of growth hormones such as auxin, gibberellins and cytokines (CARVALHO FILHO et al., 2008; VINALE et al., 2008; CONTRERAS-CORNEJO et al., 2009).

In the production of seedlings in native species, *Trichoderma* is little used, but there are results that prove the effectiveness of the fungus in the emergence and growth of cambará (*Gochnatia polymorpha* (Less.) Cabrera) and in the promotion of rubber tree growth (*Hevea brasiliensis* Muell. Arg .) (PROMWEE et al., 2014; MACHADO et al., 2015).

Considering the low fertility level of Cerrado soils, with the benefits provided by plant x Trichoderma interaction, the study aimed to evaluate the effect of Trichoderma isolates in promoting initial growth in *Myracrodruon urundeuva* Fr. All. with and without natural phosphate fertilization.

MATERIAL AND METHODS

LOCATION AND CONTAINER

The experiment was conducted from May to August 2015, in a greenhouse at the forest nursery and at the microbiology laboratory of the Federal University of Tocantins, Gurupi *campus*, located under the coordinates 11°43'45" S and 49°04 '07" N, and 280 m altitude. According to the Köppen classification (KÖPPEN & GEIGER, 1928), the region's climate is Aw, defined as hot and humid tropical with a rainy season in summer and a dry season in winter.

Two independent experiments were carried out, one with natural phosphate fertilization and the other without natural phosphate fertilization, both inoculated with *Trichoderma* isolates.

Each experiment had a completely randomized experimental design (DIC), containing 6 (six) treatments and 10 (ten) replications, with 5 (five) treatments inoculated with Trichoderma isolates and 1 (one) control without inoculation. The isolates used were T. asperelloides (UFT 201), T. harzianum (UFT 202), T. *harzianum* (UFT 203); T. longibrachiatum (UFT 204) and T. *asperelloides* (UFT 205). For the experiment with phosphate fertilization, all treatments received natural phosphate fertilization.

The vases used were sterilized according to Alfenas (1999), totaling 120 vases, with dimensions of 20 cm in height, superior diameter of 12 cm, inferior diameter of 9 cm, containing approximate volume of 1.7 liters.

ORIGIN AND ISOLATION OF THE GENUS TRICHODERMA

Twelve soil samples as potential sources of Trichoderma spp. were collected in areas of the experimental station of the Federal University of Tocantins, Campus Universitário de Gurupi (11°43'45" S and 49°04'07" W, 280 m of average altitude) and in floodplain areas in the municipality of Lagoa da Confusion - TO (10°47'37" S and 49°37'25" W, 200 m average altitude). The samples were taken at a depth of 0-10 cm in the soil profile of different crops and planting methods and sent to the Microbiology laboratory of the Federal University of Tocantins, University Campus of Gurupi, where they were stored in a cold chamber.

1 g of each soil sample was taken and deposited directly in a petri dish (9 cm in diameter), using the direct plating method, with three replications per sample, in Potato-dextrose-agar medium (PDA - Prolab-Brasil: made in syrup of 200 g of potato, 20 g of dextrose, 15 g of agar and 1000 mL of distilled water), plus Terramycin® - Pfizer (100 mg L-1), to inhibit bacterial growth in the isolation of fungi belonging to the genus Trichoderma

and incubated in a growth chamber, type B.O.D. (Biochemical, Oxygen, Demand), at a temperature of 25 ± 2 °C with a photoperiod of 12 hours, for seven days, the period necessary for the fungus to colonize the entire plate (DIANESE et al., 2012).

After seven days, the plates with typical colonies of the genus Trichoderma were selected, which stood out from the other microorganisms that grew on the plate, as they presented more aggressive growth characteristics, filling more than half of the petri dish, in addition to standing out initially white and later green. According to Domsch et al. (1980), the main morphological characteristic of the genus Trichoderma is the presence of mycelium, initially white in color and growing rapidly, as it develops it becomes cottony and compact with green spores. For Saito et al. (2009), the color varies depending on the number of spores and their pigmentation.

To confirm the genus, the colonies were transferred to petri dishes with PDA medium and, after seven days of incubation in a growth chamber at a temperature of 25 ± 2 °C with a photoperiod of 12 hours, a preliminary identification was carried out, taking into account considering only the morphological characteristics, based on specialized bibliography, with the aid of an optical microscope (BARNETT & HUNTER, 1998; ZAFARI et al., 2004), where the structures of the genus Trichoderma could be seen, resulting in five isolates of different coverings vegetables (Table 1). The isolates were kept in a refrigerator with periodic subcultures in PDA medium and preserved in water, according to Castellani's methodology (PIRES et al., 2012), for better conservation.

The isolates found were characterized by sequencing the TEF region (Translation Elongation Factor) and identified by GenBank access codes (Table 2) at Instituto Biológico de São Paulo.

SUBCULTURE OF ISOLATES

The inoculums were picked and multiplied in a petri dish containing potato-dextrose-agar (B.D.A) culture medium and incubated in B.O.D (Biochemical Oxygen Demand) at a temperature of 25 ºC and a 12-hour photoperiod for seven days (DIANESE et al., 2012).

For each isolate used, 200 g of rice were needed, moistened with 120 mL of distilled water and placed in a polypropylene plastic bag with the following dimensions: 42 cm long and 28 cm wide. The bags with the rice were closed and autoclaved at 121ºC for 60 minutes, after autoclaving the rice, five disks of isolates with a diameter of 8 mm were aseptically transferred to each bag of rice and incubated in B.O.D at a temperature of 25 ± 2 ° C with a photoperiod of 12 hours for seven days. Every two days, the rice was turned over to facilitate gas exchange, break down mycelia aggregates and increase the sporulation rate.

QUANTIFICATION OF ISOLATES

Quantification of the number of *Trichoderma* conidia was performed by placing 1 g of colonized rice in 10 mL of sterilized water, stirring for 60 seconds, and then counting the conidia in a Neubauer chamber under an optical microscope. The concentration of 1 x 109 of conidia per gram of colonized rice was used in the experiment (SANTOS, 2008).

INOCULATION OF ISOLATES IN SUBSTRATE AND SOWING

The substrate used was soil taken from the surface layer (0-20 cm) of dystrophic red-yellow latosol, medium texture, in an experimental cultivation area at the Federal University of Tocantins, Gurupi-TO, previously sieved in a 4 mm mesh. Samples

Identification of the isolates	Origin	Cultivated species
UFT 201	Lagoon of Confusion	Natural floodplain [1]
UFT 202	Lagoon of Confusion	Natural floodplain [1]
UFT 203	Lagoon of Confusion	Calopogônio (*Calopogonium mucunoides* D.)[2]
UFT 204	Gurupi	Soy (*Glycine max* (L) Merrill)
UFT 205	Gurupi	Soy (*Glycine max* (L) Merrill)

[1] Floodplain with trees and shrubby vegetation in naturally wetlands. [2]Cultivation in conventional planting.

Table 1. Identification, origin and cultivated species in the soils from which the isolates of *Trichoderma*

Isolated	Species Identification	Access GenBank	Reference
UFT 201	*T. asperelloides* GJS 04-217	DQ381958	Samuels et al. (2010)
UFT 202	*T. harzianum* CIB T23	EU279989	Hoyos-Carvajal et al. (2009)
UFT 203	*T.harzianum* CIB T23	EU279989	Hoyos-Carvajal et al. (2009)
UFT 204	*T. longibrachiatum* DAOM 167674	EU280046	Hoyos-Carvajal et al. (2009)
UFT 205	*T. asperelloides* GJS 04-217	DQ381958	Samuels et al. (2010)

Table 2. GenBank access codes for the *Trichoderma* isolates (TEF Region - translation elongation factor) used in this study

Treatments	H (cm)	CR (cm)	DC (mm)	MSPA (g)	MSR (g)	MST (g)	IQD
			50 DAS[2]				
Witness	5,1 d	6,4 c	1,2 d	0,04 e	0,03 e	0,08e	---
UFT 201	7,5 c	8,6 a	1,5 c	0,21 c	0,05 d	0,27 c	---
UFT 202	9,2 b	8,6 a	1,7 b	0,41 a	0,12 b	0,53 a	---
UFT 203	10,7 a	8,7 a	1,9 a	0,35 b	0,14 a	0,49b	---
UFT 204	6,4 cd	7,3 bc	1,6 b	0,2 c	0,07 c	0,28 c	---
UFT 205	6,3 cd	7,9 ab	1,6 b	0,17 d	0,06 d	0,23d	---
C.V(%)	13,62**	10,54**	5,88**	4,14**	8,33**	3,87**	---
			100 DAS				
Witness	9,3 c	22,8 b	2,0 b	0,33 b	0,55 c	0,89 c	0,17 c
UFT 201	19,2ab	31,2 a	3,2 a	1,7 a	2,68 ab	4,41ab	0,67 a
UFT 202	21,7 a	31,0 a	3,2 a	1,9 a	2,91 a	4,87 a	0,67 a
UFT 203	19,1ab	30,8 a	3,2 a	1,7 a	2,7 ab	4,42ab	0,67 a
UFT 204	21,4 a	28,6 a	3,1 a	1,7 a	2,40 b	4,10 b	0,53 b
UFT 205	18,5 b	24,8 b	3 a	1,8 a	2,7 ab	4,64ab	0,69 a
C.V(%)[3]	10,28**	9,61**	9,02**	12,95**	11,54**	9,8**	10,87**

[1] Means followed by the same lowercase letter in the column do not differ by Duncan's test at 1%** or 5%* probability. [2] DAS = Days after sowing. [3] Coefficient of variation.

Table 1. Mean values for height (H), root length (CR), stem diameter (DC), shoot dry mass (MSPA), root dry mass (MSR), total dry mass (MST) and Quality Index of Dickson (IQD) of *Myracrodruon urundeuva* Fr. All[1]. inoculated with Trichoderma, fertilized with natural phosphate

were taken for soil analysis, performed at the UFT Soil Laboratory, obtaining the following characteristics:Ca +Mg 2,55 cmol/dm³; Ca 1,80 cmol/dm³; Mg 0,75 cmol/dm³; Al 0,00 cmol/dm³; H+Al 5,54 cmol/dm³; K 0,21 cmol/dm³; CTC (T) 8,31 cmol/dm³; SB 2,76 cmol/dm³; K 83,54 mg/dm³ (ppm); P (Mel) 5,85 mg/dm³ (PP); V 33,27%; M 0,00%; Mat. Org. 2,56 % 25,59 g/dm³; pH $Cacl_2$ 4,80, H_2O 5,38.

After seven days of incubation in B.O.D, the Trichoderma isolates were homogeneously mixed individually with the soil in the experiments with and without phosphorus fertilization. 0.3 g of natural phosphate were used in each repetition in the experiment with phosphate fertilization, being mixed in a homogeneous together with the Trichoderma isolates. The phosphate concentrate used was Angico, obtained from Galvani (Fertilizantes Industry of Luiz Eduardo Magalhães, BA), with a total P_2O_5 content of 32%.

30 g of rice colonized with Trichoderma were used in each repetition. For the control, 30 g of sterilized rice was used. One week after the Trichoderma isolates were inoculated into the soil, 5 mastic seeds per pot were planted at a depth of 0.5 cm without previous seed treatment. Thinning was performed 15 days after planting, leaving one plant per pot.

Irrigation was done manually, twice a day, once in the morning and once in the afternoon, for 100 days.

EVALUATED PARAMETERS

Two evaluations were made, one at 50 days after sowing (DAS) and another at 100 DAS. The roots and shoots were placed in paper bags and taken to a forced circulation oven (65 to 70 ºC) until reaching a constant mass for 72 hours. The morphological parameters evaluated were: height (H); root length (CR); neck diameter (DC); shoot dry mass (MSPA); root dry mass (MSR); total dry mass (MST), in addition to evaluation of the Dickson quality index and relative efficiency. At 100 DAS in both experiments, the relative efficiency of each treatment was determined, calculated according to the formula: ER = (MSPA inoculated with the isolates/MSPA without inoculant) x 100 and IQD, Dickson's quality index, where it is done by ratio between total dry mass (MST) by the sum of the ratio between height (H) and stem diameter (DC) and the ratio of shoot dry mass (MSPA) to root dry mass (MSR), (DICKSON et al., 1960):

$$IQD = \frac{MST(g)}{H(cm) / DC(mm) + MSPA\ (g) / MSR(g)}$$

The data were submitted to analysis of variance using the statistical analysis program ASSISTAT version 7.7 beta and the averages were compared using the Duncan test at 1% or 5% probability (SILVA, 2008).

RESULTS AND DISCUSSION

MYRACRODRUON URUNDEUVA FR. ALL. WITH FERTILIZATION

For the cultivation of *Myracrodruon urundeuva* Fr. All. fertilized with natural phosphate, considering the variables DC, MSPA, MSR and MST, all isolates were superior ($p<0.01$) to the control at 50 days after sowing (DAS), table 1. The values of H, CR, DC and MSR of isolate UFT 203 were about 110, 35.9, 58.3 and 366.6% higher than the control, respectively. The UFT 202 isolate was superior ($p<0.01$) to the other isolates in MSPA and MST, being 925% and 211.7% superior in relation to the control (Table 1).

In H, DC, MSR the UFT 203 isolate was superior ($p<0.01$) to the other isolates (Table 1). For the CR variable, the isolates UFT 201, UFT 202, UFT 203 and UFT 205 did not differ from each other, but were superior ($p<0.01$) to the control and UFT 204. For MST there was a variation between the isolates from 187 to 562.5% in relation to the control (Table 1).

At 100 DAS the isolates UFT 201, UFT 202, UFT 203 and UFT 204 were superior ($p<0.01$) to the control in all evaluated parameters. UFT 205 did not differ statistically from the control, only in the root length variable, where all other isolates were statistically superior to the control, but did not differ from each other (Table 1 and Figure 1).

The H, DC, MSPA, MSR and MST values of isolate UFT 202 were about 133.3; 60; 475; 429 and 447%, higher than the control, respectively, at 100 DAS (Table 1 and Figure 1). In H, the isolates UFT 201, UFT 202, UFT 203 and UFT 204 were superior to the control, not differing from each other (Figure 2). For DC and MSPA, all isolates were statistically superior to the control and did not differ from each other. For MSR and MST the isolates UFT 201, UFT 202, UFT 203 and UFT 205 were superior and did not differ statistically from each other. In the Dickson Quality Index (DQI), the isolates UFT 201, UFT 202, UFT 203 and UFT 205 were superior ($p<0.01$) to UFT 204 and did not differ statistically from each other, ranging from 211 to 305% in relation to to the control at 100 DAS (Table 1).

As for the relative efficiency (ER), which relates the biomass of the aerial part of the treatments inoculated with *Trichoderma* with the biomass of the aerial part of the control, all isolates were superior ($p<0.01$) to the control, with no significant difference between them, with superiority of 415% in relation to the control (Figure 2).

Myracrodruon urundeuva FR. ALL. WITHOUT FERTILIZATION

At 50 DAS, the isolates used were superior ($p<0.01$) to the control in the parameters H, DC, MSPA and MST (Table 2). For H, there was no significant difference between the isolates, with averages up to 135% higher than the control. For CR the isolates UFT 201, UFT 203 and UFT 204 did not differ from the control, and the isolates UFT 202 and UFT 205 were superior ($p<0.01$) to the control by 34.78% and 44.9%, respectively. The UFT 202 isolate was superior ($p<0.01$) to the other isolates in the MSPA, MSR and MST variables, outperforming the control by 367, 275 and 325%, respectively (Table 4). In DC the isolates UFT 201, UFT 202 and UFT 204 were higher in relation to the other isolates and the control, the performance of the isolates varied from 26.5 to 41% in relation to the control.

At 100 DAS, all isolates were superior ($p<0.01$) to the control in the evaluated parameters (Table 2 and Figures 3 and 4). The isolates UFT 203 and UFT 205 were superior ($p<0.01$) to the others and the control in the H and MST parameters.

For CR, the isolates UFT 201, UFT 203 and UFT 204 were 73% superior to the control at 100 DAS (Table 2). For DC, the isolates did not differ statistically from each other, showing superiority to the control ranging from 47 to 55.8%, respectively. The isolate UFT 203 was superior ($p<0.01$) to the other isolates in MSPA, with a superiority of 71% in relation to UFT 202 and 389.7% superior to the control (Table 2). In root dry mass, the isolates UFT 202, UFT 203 and UFT 205 were superior ($p<0.01$) to the other isolates and the control, with a variation of 238 to 425.4% in relation to the control. For IQD, isolate UFT 203 was superior ($p<0.01$) to UFT 201, UFT 204 and UFT 205, differing by 39% in relation to UFT 201 and 310% for the control (Table 2 and Figure 3).

As for the relative efficiency (RE), all isolates differed statistically from the control and among the isolates UFT 203 was superior to the others (Figure 4).

Evaluating the initial growth of Myracrodruonn urundeuva Fr. All. on different substrates at 120 days, Kratka and Correia (2015) obtained the best IQD result using the proportion soil + sand + 25% bovine

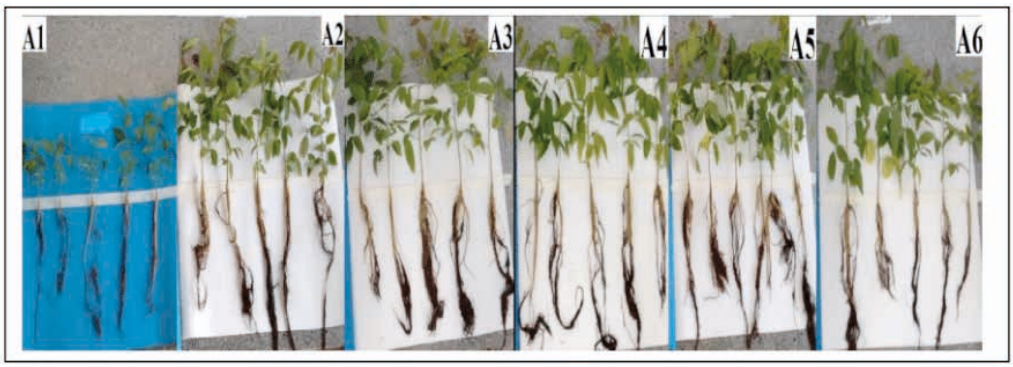

Figure 1: Aerial part and root of Myracrodruon urundeuva FR. All. Inoculated with Trichoderma isolates, with phosphorus fertilization, at 100 DAS, where A1) control,A2) UFT 201, A3) UFT 202; A4) UFT 203, A5) UFT 204 e A6) UFT 205.

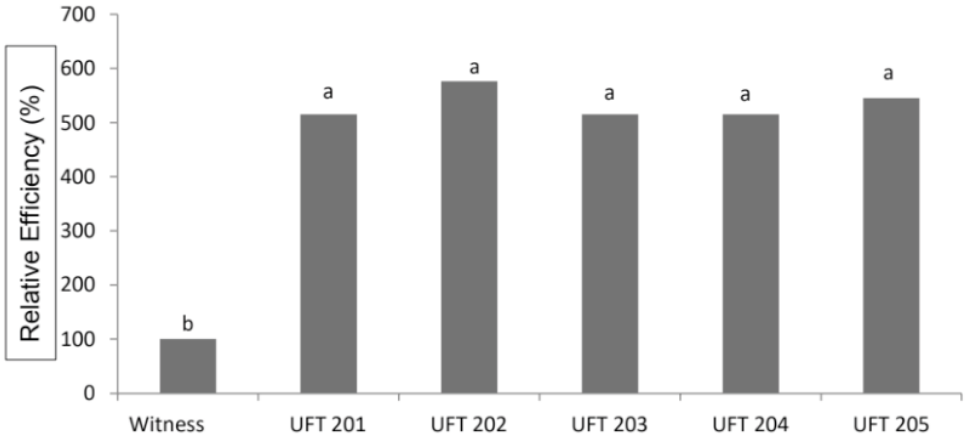

Figure 2. Relative efficiency of Myracrodruon urundeuva Fr. All. inoculated with Trichoderma isolates with natural phosphate fertilization in relation to the control without inoculation (Averages followed by the same lowercase letter do not differ by Duncan's test at 1% or 5% probability).

Treatments	H (cm)	CR (cm)	DC (mm)	MSPA (g)	MSR (g)	MST (g)	IQD
			50 DAS²				
Witness	4 b	6,9 c	1,13 c	0,077 d	0,04 d	0,12 d	---
UFT 201	9,4 a	7,4 c	1,6ab	0,28 bc	0,05 cd	0,34 c	---
UFT 202	8,8 a	9,3 ab	1,6 a	0,36 a	0,15 a	0,51 a	---
UFT 203	8,2 a	8,1 bc	1,43b	0,32 ab	0,08 b	0,40 b	---
UFT 204	9,1 a	7,8 c	1,5ab	0,29 bc	0,07 bc	0,37bc	---
UFT 205	9 a	10 a	1,47b	0,27 c	0,06 bc	0,33 c	---
C.V(%)	10,95**	12,11**	9,55**	11,28**	20,74**	10,56**	---
			100 DAS				
Witness	11 c	15 c	2,31b	0,49 d	0,59 d	1,09 d	0,19 d
UFT 201	19 b	26 a	3,4 a	1,6 c	2 c	3,75 c	0,56 c
UFT 202	19 b	23 b	3,5 a	1,4 c	3 a	4,49 b	0,73ab
UFT 203	23 a	26 a	3,6 a	2,4 a	3,1 a	5,63 a	0,78 a
UFT 204	19 b	26 a	3,52a	1,9 b	2,4 b	4,38 b	0,68 b

UFT 205	23 a	23 b	3,4 a	2,1 b	3 a	5,17 a	0,7 b
C.V(%)[3]	7,4**	7,48**	6,51**	10,83**	9,39**	9,46**	8,48**

[1] Means followed by the same lowercase letter in the column do not differ by Duncan's test at 1%** or 5%* probability.[2] DAS = Days after sowing. [3] Coefficient of variation.

Table 2. Mean values for height (H), root length (CR), stem diameter (DC), shoot dry mass (MSPA), root dry mass (MSR), total dry mass (MST) and Quality Index of Dickson (IQD) of *Myracrodruon urundeuva* Fr. All[1]. inoculated with *Trichoderma*, without natural phosphate fertilization

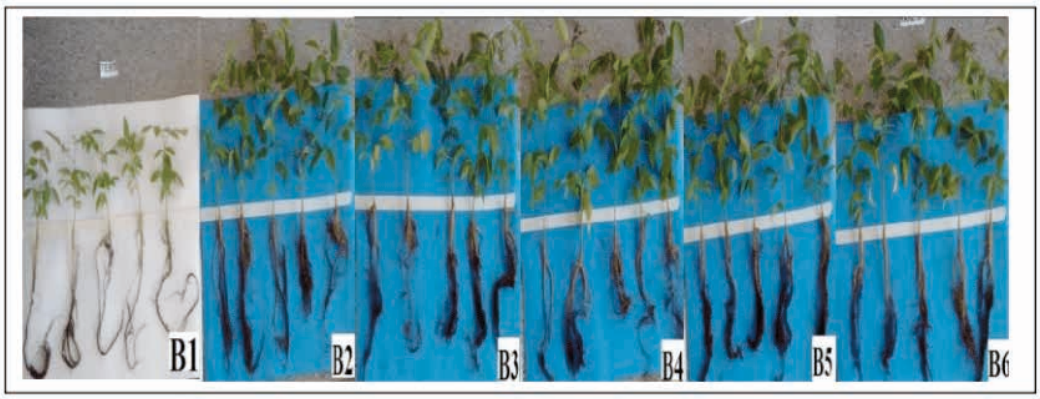

Figure 3: Aerial and root parts of all Myracrodruon urundeuva FR treatments. All. Inoculated with *Trichoderma,* without phosphate fertilization, at 100 DAS, where: B1) control; B2) UFT 201, B3) UFT 202; B4) UFT 203, B5) UFT 204 and B6) UFT 205.

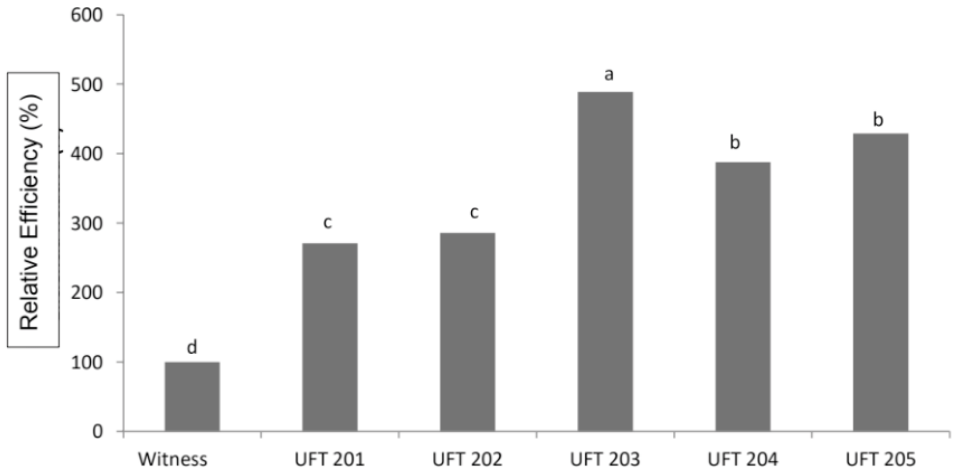

Figure 4. Relative efficiency of the species *Myracrodruon urundeuva* Fr. All. inoculated with *Trichoderma* isolates without natural phosphate fertilization in relation to the control without inoculation (Averages followed by the same lowercase letter do not differ by Duncan's test at 5% probability).

manure with a value of 0.52. At 100 days, the UFT 205 isolate with fertilization in arable soil showed a 32.6% higher IQD, with the UFT 203 isolate being 50% higher than the result obtained by Kratka and Correia (2015). The DQI results obtained using Trichoderma at 100 DAS with or without phosphate fertilization were superior to the results found by Tsukamoto Filho et al. (2013) in Myracrodruon urundeuva Fr. All., which was 0.19 at 110 days.

The promotion of plant growth provided by *Trichoderma* is attributed to the valorization of root biomass, given the greater mobilization and capture of nutrients, increasing the rate of photosynthesis in the plant (HARMAN, 2006), a result that was verified in the present work observed in the tables 3 and 4 and figures 3 and 5.

Vegetal growth can also be related to the ability of *Trichoderma* to solubilize phosphates and siderophores. Several studies report this ability (RUDRESH et al., 2005: SRIVASTAVA et al., 2013; PROMWEE et al., 2014; CHAGAS et al., 2015). Trichoderma produce organic acids such as gluconic, fumaric and citric acid that can lower soil pH by facilitating the solubilization of phosphates, micro and macro-nutrients vital to the plant such as iron, manganese and magnesium (HARMAN et al., 2004; BROTMAN et al., 2010; SRIVASTAVA et al., 2013).

Using 14 Trichoderma stems extracted from the rhizosphere of forest trees such as Pinus roxburghii, Cedrus Deodara, Bambusa bambos, Psidium guajava and Quercus sp, tested in vitro and in a greenhouse with chickpeas (Cicer arietinum L.), Kapri and Tewari (2010) confirmed the potential for phosphate solubilization of the isolates and growth promotion, likewise Chagas Junior et al. (2014) in the culture of cowpea (Vigna unguicula L. (Walp.)) cultivated in Cerrado Tocantinense soil with *Trichoderma* inoculation.

Trichoderma isolates are capable of promoting plant growth by synthesizing the hormone indoleacetic acid (IAA) (GRAVEL et al., 2007; OLIVEIRA et al., 2012). Evaluating the production of secondary metabolites in 101 Trichoderma isolates, Hoyos-Carvajal et al. (2009) found that 60% of the strains were able to produce AIA or similar to auxin.

The growth potential for fungus of the genus Trichoderma spp. it was also reported to the biocontrol and colonization capacity of the rhizosphere (HARMAN et al., 2010; BROTMAN et al., 2010). There are several defense mechanisms used by the fungus, among them the production of secondary metabolites (antibiotics) and antifungal enzymes, with more than 100 bioactive compounds, acting as hyperparasitism and competition for nutrients (YEDIDIA et al., 2003; HARMAN et al. al., 2004; WOO & LORITO, 2007; HERMOSA et al., 2012).

In short-cycle plants, the fungus Trichoderma showed an increase in biomass in several cultures surveyed. Using Trichoderma harzianum, T. strigosum and T. theobromicola in bean culture, Pedro et al. (2012) obtained a 30% increase in dry biomass and a reduction of up to 98% in anthracnose disease and systemic resistance. Milanesi et al. (2013) in soybean culture verified the potential for growth promotion by Trichoderma; in the rice crop Chagas et al. (2015) found an increase in total dry mass of 138.5% for the UFT-Tr isolate. Harz. In works with tomatoes, the fungus Trichoderma promoted the development of the aerial part varying between 116% and 900% and also developing systemic resistance (FONTENELLE et al., 2011). In black oat cultivated with T. harzianum together with rhizobia, there was an increase in the dry mass of the aerial part of the plant (MACHADO et al., 2011).

Long cycle species have also been researched

to verify the action of the Trichoderma fungus in its initial growth. In Pinus radiata using T. atroviride, Reglinski et al. (2012) verified an increase in root biomass and in more than 40%, and more than 12% in diameter in relation to the control.

In Pinus radiata Hohmann et al. (2011) found increases of 16% in height and 31% in root dry weight in relation to the control. Santos et al. (2008) evaluated the effect of isolates on the development of roots and shoots of Eucalyptus urogradis and found with isolate CEM 522 development of 79% in roots and 42.2% in shoots. In rubber tree (Hevea brasiliensis Muell. Arg.) Trichoderma increased diameter by 13.81%, height by 22.19%, shoot dry mass by 39.96%, and root dry mass by 21.13% compared to the witness (PROMWEE et al., 2014). In cambará (Gochnatia polymorpha) T. harzianum promoted growth of 165.7% for height, 1700% for root dry biomass and 2940% for MSPA in relation to the control (MACHADO et al., 2015).

The action of fungi that promote growth in plants is specific and may vary according to the environment, substrate used, climate, humidity, strain used, availability of nutrients as well as interference from other microorganisms.

Altomare et al. (1999) evaluating the species T. *harzianum* as a solubilizer of poorly soluble minerals(Fe_2O_3, MnO_2, CuO, Zn e P) obtained positive results on the potential to promote solubilization of this isolate. Li R-X et al. (2015) did not verify the solubilization of $Ca_3(PO_4)_2$ or MnO_2 by *Trichoderma.* Altomare et al. (1999) did not verify the release of organic acids by *T. harzianum* T22. Adans et al. (2007) verified the chelation of metals through the acidification of Trichoderma in the desorption of metals.

Due to this range of factors that can influence the action of this fungus and considering the economic and environmental importance of native forest species, the results are relevant for the improvement of silvicultural techniques, requiring more specific studies to know the mechanisms that promote the growth of forest seedlings by *Trichoderma*.

CONCLUSION

The inoculation of different species of Trichoderma promoted the plant growth of *Myracrodruon urundeuva* Fr. All. fertilized or not with natural phosphate.

REFERENCES

ADAMS, P.; DE-LEIJ, F. A.; LYNCH, J. M. *Trichoderma harzianum* rifai 1295–22 mediates growth promotion of crack willow (*Salix fragilis*) saplings in both clean and metal-contaminated soil. **Microb. Ecol.,** v. 54, n. 2, p. 306–313, 2007.

ALFENAS, A. C. Mofo Cinzento Causado por *Botrytis cinérea* (Persoon ex Fries) em estacas e microestacas de *Eucalyptus* sp. resistência a benomil e erradicação de inoculo do patógeno com água quente**. Revista** Árvore, v. 4, p. 497-500, 1999.

ALTOMARE, C.; NORVELL, W. A.; BJÖRKMAN, T.E.; HARMAN, G.E. Solubilization of phosphates and micronutrients by the plant-growth-promoting and biocontrol fungus *Trichoderma harzianum* Rifai. 1295-22. **Applied and Environmental Microbiology**, v. 65, n. 7, p. 2926-2933, 1999.

BARNETT, H. L.; HUNTER, B. B. 1998. Illustrated genera of imperfect fungi. Minnesota: **Burgess Publishing Company**, 4 ed. 218 p., 1998.

BROTMAN, Y.; GUPTA, K. J.; VITERBO, A. *Trichoderma*. **Current Biology**, v. 20, p. 390-391, 2010.

CARVALHO FILHO, M. R.; MELLO, S. C. M. de; SANTOS, R. P. dos; MENÊZES, J. E. **Avaliação de isolados de *Trichoderma* na promoção de crescimento, produção de ácido indolacético in vitro e colonização endofítica de mudas de eucalipto**. Brasília: Embrapa Recursos Genéticos e Biotecnologia, 13p. Boletim de pesquisa e desenvolvimento, 226, (2008).

CHAGAS JUNIOR, A. F.; OLIVEIRA, A. G.; REIS, H. B.; SANTOS, G. R.; CHAGAS, L. B.; MILLER, L. O. Efficiency of combined inoculation of *rhizobia* and *Trichoderma* spp. in different cultivars of cowpea (*Vigna unguiculata*) in the "cerrado" (Brazilian savanna). **Revista de Ciências Agrárias**, v. 37, n. 1, p. 20-28, 2014.

CHAGAS, L. F. B.; CHAGAS JUNIOR, A. F.; CARVALHO, M. R.; MILLER, L. O.; COLONIA, B. S. Evaluation of the phosphate solubilization potential of *Trichoderma* strains (*Trichoplus* JCO) and effects on rice biomass**. Journal of Soil Science and Plant Nutrition**, v. 15, n. 3, p. 794-804, 2015.

CONTRERAS-CORNEJO, H. A.; MACÍAS-RODRÍGUEZ, L.; CORTÉS-PENAGOS, C. & LÓPEZ-BICIO, J. *Trichoderma virens*, a plant beneficial fungus, enhances biomass production and promotes lateral root growth through an auxin-dependent mechanism in *Arabidopsis*. **Plant Physiology,** v. 149, n. 3, p. 1579–1592, 2009.

DIANESE, A. C.; BLUM, L. E. B.; MELLO, S. C. M. Uso de *Trichoderma* spp. para o manejo da podridão-do-pé-do-mamoeiro causada por *Phytophthora palmivora* Butler. Planaltina-DF: **Embrapa Cerrados,** 18 p. 2012.

DICKSON, A.; LEAF, A. L.; HOSNER, J. F. Quality appraisal of white spruce and white pine seedling stock in nurseries. **For. Chron**., v. 36, p. 10-13,1960.

DOMSCH, K.H.; GAMS W.; ANDERSON T.H. **Compendium of soil fungi**. Acad. Press, London, v.1 e 2. 859 p.1980.

FONTENELLE, A. D. B.; GUZZO, S. D.; LUCON, C. M. M.; HARAKAVA, R. Growth promotion and induction of resistance in tomato plant against *Xanthomonas euvesicatoria* and *Alternaria solani* by *Trichoderma* spp. **Crop Protection**, v. 30, p. 1492-1500, 2011.

GAMALERO, E., ERTA, G.; GLICK, B. R. The use of microorganisms to facilite the growth of plants in saline soils. p. 1-22. In: **Microbial Strategies for Crop Improvement**. M. S. Khan, A. Zaidi, and J. Musarrat, eds. Springer-Verlag, Heidelberg, 2009.

GRAVEL, V.; ANTOUN, H.; TWEDDELL, R. J. Growth stimulation and fruit yield improvement of greenhouse tomato plants by inoculation with *Pseudomonas putida* or *Trichoderma atroviride*: possible role of indole acetic acid (IAA). **Soil Biology and Biochemistry,** v. 39, n. 8, p. 1968-1977, 2007.

HARMAN G. E.; OBREGÓN; M. A.; SAMUELS, G. J.; LORITO, M. Changing Models for Commercialization and Implementation of Biocontrol in the Developing and the Developed World. **Plant Disease,** v. 94, p. 928-939, 2010.

HARMAN, G. E. Overview of mechanisms and uses of *Trichoderma* spp. **Phytopathology**, v. 96, p. 190-4, 2006.

HARMAN, G. E. Microbial tools to improve crop performance and profitability and to control plant diseases. p. 71-84. In: **Proc. Int. Sympos. Biol. Control Plant Dis**. New Century–Mode Action Applic. Technol. D. D. S. TZENG and J. W. HUANG (ed.) National Chung Hsing University, Taichung City, Taiwan, 2001.

HERMOSA, R.; VITERBO, A.; CHET, I.; MONTE, E. Plant-beneficial effects of *Trichoderma* and of its genes. **Microbiology**, v. 158, n. 1, p. 17–25, 2012.

HOHMANN, P.; JONES, E. E.; HILLA, R. A.; STEWART, A. Understanding *Trichoderma* in the root system of *Pinus radiata*: associations between rhizosphere colonisation and growth promotion for commercially grown seedlings. **Fungal biology,** v. 115, p. 759-767, 2011.

HOLFORD, I. C. R. Soil phosphorus: its measurement, and its uptake by plants. **Australian Journal of Soil Research**, v. 35, p. 227-239, 1997.

HOYOS-CARVAJAL, L.; ORDUZ, S.; BISSETT, J. Growth stimulation in bean (*Phaseolus vulgaris* L.) by *Trichoderma*. **Biological Control**, v. 51. p. 409-416, 2009.

IBAMA.INSTITUTO BRASILEIRO DO MEIO AMBIENTE E DOS RECURSOS NATURAIS RENOVÁVEIS. Lista Oficial das Espécies da Flora Brasileira Ameaçadas de Extinção. IBAMA;2008. Disponível em: <http://www.mma.gov.br/estruturas/ascom_boletins/_arquivos/83_19092008034949.p df.> Acesso em outubro, 2014.

KAPRI, A.; TEWARI, L. Phosphate solubilization potential and phosphatase activity of rhizospheric *Trichoderma* spp. **Brazilian Journal of Microbiology**, v. 41, n. 3, p. 787-795, 2010.

KLEIFELD, O.; CHET, I. *Trichoderma harzianum* – interaction with plants and effect on growth response. **Plant and Soil**, v. 144, p. 267-272, 1992.

KÖPPEN, W.; GEIGER, R. **Klimate der Erde**. Gotha: Verlag Justus Perthes. Wall- map 150cmx200cm.1928.

KRATKA, P. C.; CORREIA, C. R. M. A.; Crescimento inicial de aroeira do sertão (*Myracrodruon urundeuva* allemão) em diferentes substratos. **Revista** Árvore, v. 39, n. 3, p. 551-559, 2015.

LI R-X, C. F.; PANG, G.; SHEN, Q. R.; LI, R.; CHEN, W. Solubilisation of phosphate and micronutrients by *Trichoderma harzianum* and Its relationship with the promotion of tomato plant growth. **PLOS ONE,** v. 10, n. 6, p. 1-15, 2015.

LORENZI, H. Árvores brasileiras: manual de identificação e cultivo de plantas **arbóreas nativas do Brasil**. São Paulo: Plantarum, 1: 368p. 1992.

MACEDO, A. C. **Produção de Mudas em viveiros florestais: espécies nativas**. MACEDO, A. C. (Ed.). São Paulo: Fundação Florestal. 18 p. 1993.

MACHADO, D. M.; TAVARES, A. P.;LOPES, S. J.;SILVA, C. F. *Trichoderma* spp. na emergência e crescimento de mudas de cambará (*Gochnatia polymorpha* (Less.) Cabrera). **Revista** Árvore, v. 39, n. 1, p. 167-176, 2015.

MACHADO, R. G.; DE AS, E. L. S.; DAMASCENO, R. G.; HAHN, L.; ALMEIDA, D.; MORAIS, T.; CAMARGO, F. A. O.; REARTES, D. S. Promoção de crescimento de *Lotus corniculatus L.* e *Avena strigosa Schreb* pela inoculação conjunta de *Trichoderma harzianum* e rizóbio. **Ciencia e Natura**, v. 33, n. 2, p. 111-126, 2011.

MAPBIOMAS. 2021.. Desmatamento Em 2021 Aumentou 20%, Com Crescimento Em Todos Os Biomas. Disponível em: <. https://mapbiomas.org/desmatamento-em-2021-aumentou-20-com-crescimento-em-todos-os-biomas-1>. Acesso em: 02/03/2023.

MILANESI, P. M.; BLUME, E.; MUNIZ, M. F. B.; REINIGER, L. R. S.; ANTONIOLLI, Z. I.; JUNGES, E.; LUPATINI, M. Detecção de *Fusarium* spp. e *Trichoderma* spp. e antagonismo de *Trichoderma* sp. em soja sob plantio direto. **Semina: Ciências Agrárias**, v. 34, n. 6, p. 3219-3234, 2013.

OLIVEIRA, A. G.; CHAGAS JUNIOR, A. F.; SANTOS, G. R.; MILLER, L. O.; CHAGAS, L.F.B. Potencial de solubilização de fosfato e produção de AIA por *Trichoderma* spp. **Revista Verde**, v. 7, n. 3, p. 149-155, 2012.

PEDRO, E. A. S.; HARAKAVA, R.; LUCON, C. M. M.; GUZZO, S. D. Promoção do crescimento do feijoeiro e controle da antracnose por *Trichoderma* spp. **Pesquisa Agropecuária Brasileira**, v. 47, n. 11, p. 1589-1595, 2012.

PIRES, G. C. C.; APARECIDO, C. C.; FINATTI, D. Preservação em laboratório de fungos filamentosos por longos períodos de tempo. **Biológico**, v. 74, n. 1, p. 9-16, 2012.

PROMWEE, A.; KRAISILA, M. I.; INTANA, W.; CHAMMWARNG, C.; YENJIT, P. Phosphate solubilization and growth promotion of rubber tree (*Hevea brasiliensis* Muell. Arg.) by *Trichoderma* Strains**. Journal of Agricultural Science**; v. 6, n. 9, p. 8-20, 2014.

RIZZINI C.T. Árvores **e madeiras** úteis **do Brasil: manual de dendrologia brasileira.** 2ª ed. São Paulo: Edgard Blucher, 296 p. PMid:3498162. 1987.

REGLINSKI, T.; RODENBURG, N.; TAYLOR, J. T.; NORTHCOTT, G.L.; AH CHEE, A.; SPIERS, T. M.; HILL, R. A. *Trichoderma atroviride* promotes growth and enhances systemic resistance to Diplodia pinea in radiata pine (*Pinus radiata*) seedlings.**Forest Pathology**, v. 42, p. 75–78, 2012.

RUDRESH, D. L.; SHIVAPRAKASH, M. K.; PRASAD, R. D. Effect of combined application of *Rhizobium*, phosphate solubilizing bacterium and *Trichoderma* spp. on growth uptake and yield of chickpea (*Cicer aritenium* L.). **Applied Soil Ecology**, v. 28, p. 139-146, 2005.

SAITO, L. R.; SALES, L. L. S. R.; MARTINCKOSKI, L.; ROYER, R.; RAMOS, M. S. de.; REFFATTI, T. Aspectos dos efeitos do fungo *Trichoderma* spp. no biocontrole de patógenos de culturas agrícolas. **Pesquisa Aplicada & Agrotecnologia**, v. 2, n. 3. 2009.

SANTARELLI, E. G. Produção de mudas de espécies nativas para florestas ciliares. In: RODRIGUES, R. R.; LEITÃO FILHO, H. F. (Eds.). **Matas Ciliares: conservação e recuperação.** 2. ed. São Paulo: Edusp/Fapesp, 2004.

SANTOS, R. P.; CARVALHO FILHO, M. R; MARTINS, I. **Avaliação de Isolado de *Trichoderma* ssp. e *Gliocladium Virens* na Promoção do Crescimento em mudas de Eucalipto e na Produção de Ácido Idolacético In Vitro.** Embrapa, Recursos Genéticos e Biotecnológicos, Boletim de Pesquisa e Desenvolvimento 232, Brasília, DF, p. 07, 2008.

SHERAMETI, I., SHAHOLLARI, B., VENUS, Y., ALTSCHMIED, L., VARMA, A.; OELMUELLER, R. The endophytic fungus *Piriformospora indica* stimulates the expression of nitrate reductase and the starch-degrading enzyme glucan-water dikinase in tobacco and *Arabidopsis* roots through a homeodomain transcription factor that binds to a conserved motif in their promoters. **J. Biol. Chem**., v. 280, p. 26241-26247, 2005.

SILVA, F. de A. S. **ASSISTAT**. Versão 7.6 beta. Campina Grande, 2008. Disponível em: <http://www.assistat.com/indexp.html>. Acesso em: 15 mar. 2015

SRIVASTAVA, R.; KHALID, A.; SINGH, U.S. E SHARMA, A. K. Evaluation of arbuscular mycorrhizal fungus, fluorescente Pseudomonas and *Trichoderma harzianum* formulation against *Fusarium oxysporum* f. sp. lycopersici for the management of tomato wilt. **Biological Control***,* v. 53, n. 1, p. 24-31, 2010.

SRIVASTAVA, M. P.; TIWARI, R.; SHARMA, N. Effect of diferente cultural variables on siderophores produced by *Trichoderma* spp. **International Journal of Advanced Research,** v. 1, n. 7, p. 1-6, 2013.

TAIZ, L.; ZEIGER, E. **Fisiologia vegetal.** 3.ed. Porto Alegre: Artmed, 719 p., 2004. TSUKAMOTO FILHO, A. A.; CARVALHO, J. L.; COSTA, R. B.; DALMOLIN, A. C.; BRONDANI, G. E. Regime de Regas e Cobertura de Substrato Afetam o Crescimento Inicial de Mudas de *Myracrodruon urundeuva.* **Floresta e Ambiente**; v. 20, n. 4, p. 521-529, 2013.

VINALE, F.; SIVASITHAMPARAM, K.; GHISALBERTI, E. L.; MARRA, R.; BARBETTI, M. J.; LI, H.; WOO, S. L.; LORITO, M. A noel role for *Trichoderma* secondary metabolites in the interactions with plants. **Physiological and Molecular Plant Pathology**, v. 72, p. 80-86, 2008.

WALLER, F.; ACHATZ, B.; BALTRUSCHAT, H.; FODOR, J.; BECKER, K.; FISCHER, M.; HEIER, T.; HUECKELHOVEN, R.; NEUMANN, C.; VON WETTSTEIN, D.; FRANKEN, P.; KOGEL, K.H. The endophytic fungus *Piriformospora indica* reprograms barley to salt-stress tolerance, disease resistance, and higher yield. **PNAS**, v. 102, p. 13386-13391, 2005.

WOO, S. L.; LORITO, M. Exploiting the interactions between fungal antagonists, pathogens and the plant for biocontrol. In: VURRO, M.; GRESSEL, J. (Ed.). **Novel biotechnologies for biocontrol agent enhancement and management**. Amsterdam: Springer, p. 107-130. 2007.

WORLD WILDLIFE FUND - WWF, 2019. O alerta que vem do Cerrado. Disponível em: <https://www.wwf.org.br/?21400/O-alerta-que-vem-do-cerrado#:~:text=A%20degrada%C3%A7%C3%A3o%20do%20bioma%2C%20causada,servi%C3%A7os%20ecol%C3%B3gicos%20desse%20importante%20bioma.>. Acesso em: 02/03/2023.

YEDIDIA, I., M.; SHORESH, K.; KEREM, N.; BENHAMOU, Y.; KAPULNIK, I.; CHET. Concomitant induction of systemic resistance to *Pseudomonas syringae* pv. lachrymans in cucumber by *Trichoderma asperellum* (T-203) and the accumulation of phytoalexins. **Appl**. **Environ. Microbiol**., v. 69, p. 7343-53, 2003.

ZAFARI, D., ZARE, R., ERSHAD, D. and ALIZADEH, A. Introduction of three new species of *Trichoderma* for mycoflora of Iran. **Rostaniha**, v. 5, p. 63-65, 2004.