



GERMINATION OF FORAGE SEEDS IN PYROLIGNEOUS EXTRACT

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ABSTRACT

Objective: The objective of this study was to evaluate the effect of different pyroligneous extracts on the germination and development of seeds of *Brachiaria decumbens* cv. Basilisk, *Panicum maximum* cv. Miyagui, and *Zea mays*, aiming to identify which concentration produces favorable effects for plant establishment.

Theoretical Framework: In the literature, the use of pyroligneous extract is reported with promising results as an antifungal and antibacterial agent, as a soil conditioner, and in promoting shoot development, rooting, and pseudobulb formation in orchid species, as well as in increasing tillering in sugarcane cultivation.

Method: The study was conducted in a B.O.D.-type germinator using three commercial pyroligneous extracts (black – EPP, yellow – EPA, and culinary – EPC) at the following dilutions in distilled water: 0, 0.5, 1.0, 2.5, and 5.0% (v.v⁻¹). The seeds were immersed for 16 hours, following the procedures established by the Rules for Seed Testing of the Ministry of Agriculture and Agrarian Reform.

Results and Discussion: In general, the extracts produced varied effects, causing a reduction in germination and root meristem development in *B. decumbens* cv. Basilisk, but promoting apical meristem development at lower concentrations. For *P. maximum* cv. Miyagui, the extracts favored germination and both apical and root meristem development (except for EPA), although these effects were suppressed at higher doses. In maize, no regression adjustment was observed for germination with EPP, but favorable effects were noted with EPA and EPC at lower concentrations.

Research Implications: The study records different responses in germination and meristem development, indicating beneficial or even toxic effects depending on the type and/or concentration of the extracts. These results

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are relevant for the initial cultivation of economically important plants and for the evaluation of certain commercially available product varieties.

Originality/Value: This study provides data and behavioral records for tropical grasses in relation to the use of extracts marketed for the agricultural sector and even for human culinary use, aiming to compare products with different levels of filtration and diverse chemical compositions.

Keywords: Agroindustrial Waste, Liquid Smoke, Germination, Meristematic Development.

GERMINAÇÃO DE SEMENTES FORRAGEIRAS EM EXTRATO PIROLENHOSO

RESUMO

Objetivo: O objetivo deste estudo foi o de avaliar o efeito de diferentes extratos pirolenhosos na germinação e desenvolvimento de sementes de *Brachiaria decumbens* cv Basilisk, *Panicum maximum* cv Miyagui e *Zea mays*, com o intuito de ser obtido um indicativo de qual, entre suas dosagens, desencadeie efeitos favoráveis para o estabelecimento de plantas.

Referencial Teórico: Na literatura o uso de extrato pirolenhoso é relatado com resultados promissores como agente antifúngico, antibacteriano, condicionador do solo, em melhorias no desenvolvimento de parte aérea e enraizamento e pseudobulbos em espécies de orquídeas e no aumento de perfilhos no cultivo de cana-de-açúcar.

Método: O estudo ocorreu em germinador tipo B.O.D. com três extratos pirolenhosos comerciais (preto – EPP, amarelo – EPA e culinário – EPC) nas diluições, em água destilada, de: 0; 0,5; 1,0; 2,5 e 5,0% (v.v⁻¹). As sementes foram submetidas a 16 horas de imersão tendo os procedimentos em referência as Regras para Análise de Sementes do Ministério da Agricultura e Reforma Agrária.

Resultados e Discussão: De forma geral, os extratos promoveram efeitos variados, gerando depressão na expressão da germinação e desenvolvimento do meristema radicular em *B. decumbens* cv Basilisk mas promovendo o desenvolvimento do meristema apical de suas sementes em baixas concentrações. Para *P maximum* cv Miyagui os extratos favoreceram a germinação e o desenvolvimento dos meristemas apical e radicular (exceto EPA) mas deprimindo essas características nas maiores doses. Em milho não foi obtido ajuste regressivo quanto a germinação em EPP mas observou-se efeitos favoráveis em EPA e EPC nas menores doses.

Implicações da Pesquisa: O estudo registra diferentes comportamentos quanto a germinação e no desenvolvimento dos meristemas apical e radicular sendo indicado efeitos benéficos ou mesmo de toxidez em relação ao tipo e/ou doses avaliadas dos diferentes extratos. Tais resultados são importantes no cultivo inicial de plantas de interesse econômico e em função de certas variedades de produtos disponíveis no comércio.

Originalidade/Valor: Este estudo contribui com dados e registro de comportamento para gramíneas tropicais em relação ao uso de extratos indicados para o setor agropecuário e mesmo para culinária humana, estudado aqui na intenção de contratar produtos com diferentes graus de filtragem e substâncias diversas.

Palavras-chave: Resíduos Agroindustriais, Fumaça Líquida, Germinação, Desenvolvimento Meristemático.

GERMINACIÓN DE SEMILLAS FORRAJERAS EN EXTRACTO PIROLENHOSO

RESUMEN

Objetivo: El objetivo de este estudio fue evaluar el efecto de diferentes extractos pirolenhosos en la germinación y el desarrollo de semillas de *Brachiaria decumbens* cv. Basilisk, *Panicum maximum* cv. Miyagui y *Zea mays*, con el fin de identificar cuál de sus concentraciones desencadena efectos favorables para el establecimiento de plantas.

Marco Teórico: En la literatura, el uso de extracto pirolenhoso se informa con resultados prometedores como agente antifúngico, antibacteriano, acondicionador del suelo, en la mejora del desarrollo de la parte aérea, del enraizamiento y de los pseudobulbos en especies de orquídeas, así como en el aumento del número de macollos en el cultivo de caña de azúcar.



Método: El estudio se llevó a cabo en un germinador tipo B.O.D., con tres extractos pirolenhosos comerciales (negro – EPP, amarillo – EPA y culinario – EPC) en las siguientes diluciones en agua destilada: 0, 0,5, 1,0, 2,5 y 5,0% (v.v⁻¹). Las semillas fueron sometidas a 16 horas de inmersión, siguiendo los procedimientos establecidos en las Reglas para el Análisis de Semillas del Ministerio de Agricultura y Reforma Agraria.

Resultados y Discusión: En general, los extractos produjeron efectos variados, causando una reducción en la germinación y el desarrollo del meristemo radicular en *B. decumbens* cv. Basilisk, pero promoviendo el desarrollo del meristemo apical de sus semillas en bajas concentraciones. Para *P. maximum* cv. Miyagui, los extractos favorecieron la germinación y el desarrollo de los meristemos apical y radicular (excepto EPA), aunque esos efectos fueron reducidos en las dosis más altas. En maíz, no se observó un ajuste regresivo en la germinación con EPP, pero se identificaron efectos favorables con EPA y EPC en las concentraciones más bajas.

Implicaciones de la investigación: El estudio registra diferentes comportamientos en cuanto a la germinación y al desarrollo de los meristemos apical y radicular, indicando efectos beneficiosos o incluso tóxicos en función del tipo y/o concentración de los extractos evaluados. Estos resultados son importantes para el cultivo inicial de plantas de interés económico y para la evaluación de distintas variedades de productos disponibles comercialmente.

Originalidad/Valor: Este estudio aporta datos y registros de comportamiento para gramíneas tropicales en relación al uso de extractos recomendados para el sector agropecuario e incluso para el uso culinario humano, estudiados aquí con el objetivo de comparar productos con diferentes niveles de filtración y diversas sustancias.

Palabras clave: Residuos Agroindustriales, Humo Líquido, Germinación, Desarrollo Meristemático.

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1 INTRODUCTION

Over the past forty years, the transformation of Brazilian livestock farming has been characterized by the modernization of cattle raising methods, resulting in a significant increase in the number of animals and the optimization of production efficiency (Matta Neto *et al.*, 2010). Under these circumstances, Brazil has the largest commercial herd in the world, with approximately 234.3 million head (IBGE, 2022). Approximately 24.3% of the country's Gross Domestic Product (GDP) comes from agricultural activity, with 30.0% of this accumulation being the responsibility of beef and dairy cattle farming, therefore, with economic and social relevance for the country (CEPEA, 2023). In this scenario, the state of Rondônia is the second in the agricultural ranking of the northern region, with almost 21 billion reais, responsible for 1.7% of the gross value of national production (IBGE, 2022). Livestock activity represents more than 10 billion reais, around 51% of the Gross Value of Agricultural Production – VBP of December 2023 (SEAGRI, 2023). However, it is among the most deforested states in the northern region (MapBiomass, 2021), with the area designated for pastures estimated at 7.1 million hectares (RODRIGUES *et al.*, 2020), of which 70.4% are in some stage of degradation (SEAGRI, 2024).



One of the alternatives that can contribute to the recovery of pasture agroecosystems is the use of pyroligneous extract or liquid smoke. It is one of the byproducts of the charcoal manufacturing process that has shown promising results as an antifungal and antibacterial agent (Araújo, 2018), as a soil conditioner (Miyasaka *et al.* , 2001), in improving the development of aerial parts, rooting and pseudobulbs in orchid species (Schnitzer *et al.* , 2010), in increasing tillers in sugarcane cultivation (Uddin *et al.* , 1995) and can also positively influence seed germination and plant regrowth (Souza *et al.* , 2012; Wang *et al.* , 2019).

Brazil stands out in the production of charcoal, accounting for around 42.8% of a production of 136.6 million m³ of firewood destined for the production of charcoal in 2005 (Manzoni & Barros, 2021) . Currently, the steel industry stands out as one of the main consumers of charcoal in the country, absorbing more than 90% of all national production (MME-EPE, 2023) .

Obtaining pyroligneous extract can be considered simple, since it occurs by adapting a pipe to the charcoal oven, which allows the condensation of the smoke resulting from the pyrolysis of wood (Campos, 2018). However, its chemical composition is directly related to the heating temperature inside the oven and the type of wood being burned (Than & Suluksna, 2018) and, therefore, it is a complex mixture of carboxylic acid, resulting from a variety of chemical reactions involving the components of wood, such as cellulose, hemicellulose, lignin and phenolic compounds (Campos, 2018). To obtain this product, high quality must be guaranteed in order to minimize the presence of tar, which is highly polluting and contains carcinogenic substances, such as benzopyrenes and others (Campos, 2007). There is a wide supply of pyroligneous extract available on the market. Thus, the objective of this study was to evaluate the influence of pyroligneous extracts on the germination and development of apical meristem of grass seeds.

2 METHODOLOGY

The experiment was conducted between August 8th and 23rd, 2024 at the Agronisse Seed Laboratory in Rolim de Moura - Rondônia. Concentrations of 0.5; 1.0; 2.5 and 5.0% were established to evaluate the germination and initial development of brachiaria (*Brachiaria decumbens* cv Basilisk), panicum (*Panicum maximum* cv Miyagui) and corn (*Zea mays* L.).

The pyroligneous extract used in this study was purchased from a reputable local store and had the following initial characteristics (Table 1). Due to their colors or indication of use, for this study they are named as: black pyroligneous extract (EPP), yellow pyroligneous extract



(EPA) and culinary pyroligneous extract (EPC) to facilitate distinction. In contrast to those indicated for agriculture, culinary pyroligneous extract was included in order to represent another form regarding the filtration and purification process for product quality.

Table 1

Some characteristics of pyroligneous extracts (EP) acquired in commerce in the Rondônia forest area

EP	Features	Odor	pH*
EPP	Black/Opaque	Smoked	3.98
EPA	Strong yellow/translucent	Woody	2.85
EPC	Black/ human food	Smoked	3.22

*Data obtained using the AKSO AK88 multiparameter probe. Source: The Author/ GEPAAR.

The extracts were diluted in distilled water, according to the treatments (EPP, EPA and EPC – 0.5%, 1.0%, 2.5% and 5% vv⁻¹) and distributed in plastic cups. From these procedures, the seeds were subjected to 16 hours of immersion. Subsequently, 50 seeds of the forages *B. decumbens* and *P. maximum* were placed in transparent acrylic boxes lined with a sheet of Germitest® paper and also of *Z. mays* L. only arranged on Germitest® paper, according to the Rules for Seed Analysis – RAS (BRASIL, 1992) with a control group and two replicates per treatment.

The germinator used in the experiment was a vertical BOD (Biochemical Oxygen Demand) chamber containing 10 removable wire shelves, temperature control, photoperiod and air circulator. The seeds were subjected to a 16-hour photoperiod, maintaining the temperature at 30 degrees Celsius, followed by an 8-hour shutdown period, with the temperature controlled at 20 degrees Celsius.

The evaluation was carried out to determine the influence of the pyroligneous extract on the development of the apical meristem of the stem (cm) and root (cm) and the germination percentage (PG) of the seeds. The growth of the meristems was evaluated 15 days into the experimental period using graph paper with a centimeter-scale ruler, and the germinated seedlings were evaluated daily by the absolute count of the germinated seeds. Thus, the final count to calculate the germination percentage was conducted 15 days after sowing.

The experiment was carried out individually for each species in a completely randomized design and the results were subjected to analysis of variance and for the comparison tests of the treatment means, the Tukey test at 5% and regression through the R 4.3.0 language (R Core Team, 2023) were used. For the RStudio software, the ExpDes.pt package (Ferreira,



2013) was used.

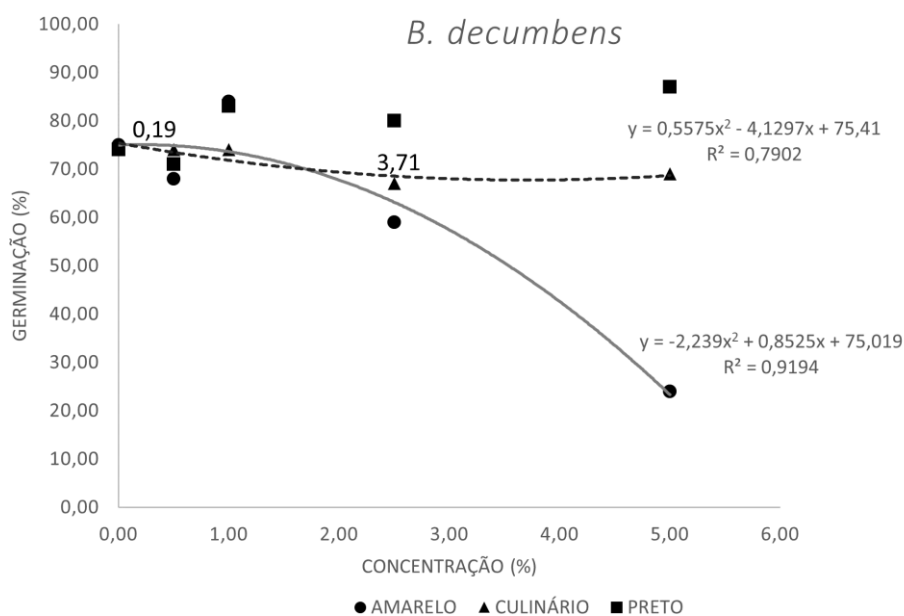
3 RESULTS

The responses observed regarding the variables: germination percentage (PG), length of the apical meristem of the stem (cm) and length of the root meristem (cm) of the seeds, led to different results between the concentrations in the species evaluated.

Regarding *Brachiaria decumbens* cv Basilisk, for the seed germination variable, the culinary pyroligneous extract (EPC) and the black pyroligneous extract (EPP) presented behavior with little change or even without statistical significance in relation to the control, however, for the yellow pyroligneous extract (EPA) a drastic reduction in seed germination was obtained with the increase in concentration (Figure 1).

Figure 1

Germination percentage of brachiaria seeds (Brachiaria decumbens cv Basilisk) in relation to the concentration of Pyroligneous Extracts.

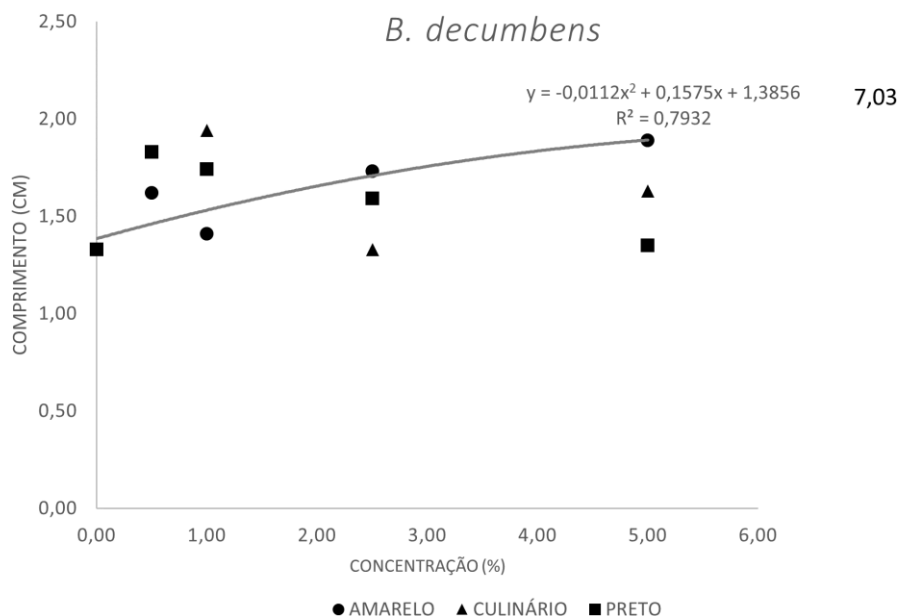


For the development of meristems, only EPA showed significant behavior in the regression (Figure 2).



Figure 2

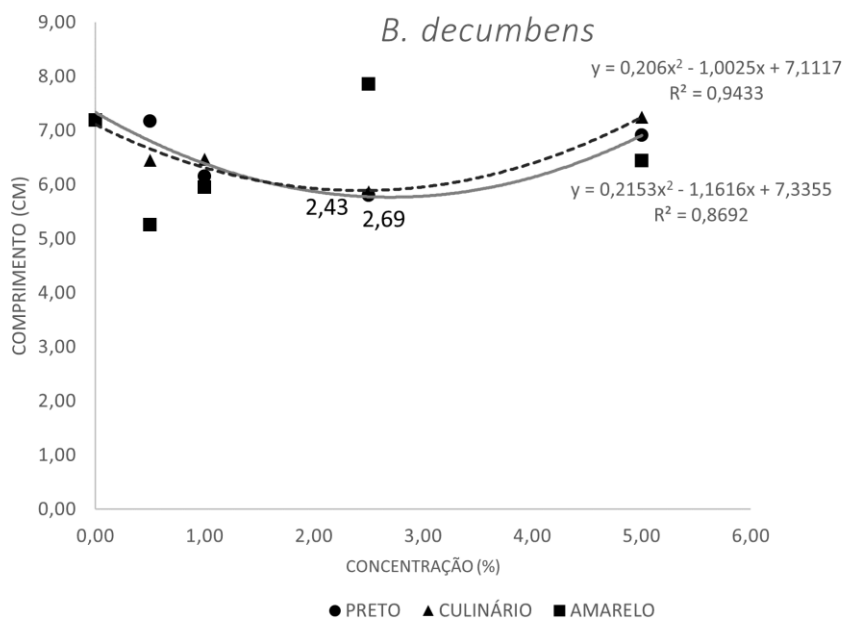
Development of the apical meristem of brachiaria seeds (Brachiaria decumbens cv Basilisk) in relation to the concentration of Pyroligneous Extracts.



The root meristem did not show significant development in the concentrations tested (Figure 3).

Figure 3

Development of the root meristem of brachiaria seeds (Brachiaria decumbens cv Basilisk) in relation to the concentration of Pyroligneous Extracts.



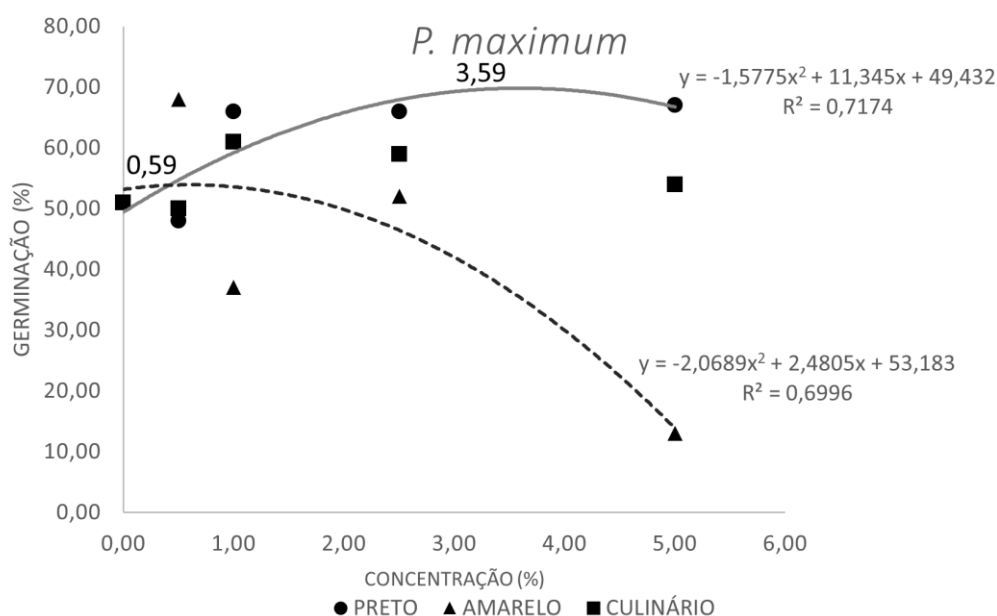


The results of root and shoot apical meristem for the species *B. decumbens* showed an increase of 9.93% and 45.38% at concentrations of 2.5% and 5%, respectively, in the EPA treatment.

In the Miyagui germination evaluation, it is possible to observe an increase in concentration with EPP treatment up to a concentration of 3.59% (Figure 4); however, in contrast to these results, meristematic development is impaired at concentrations close to this (Figures 5 and 6). The opposite occurs with the use of EPA regarding the increase in concentration, impairing germination (Figure 4); however, at a concentration close to 2.0% it helps in the development of apical meristems (Figures 5 and 6); the optimal concentration can be obtained through the average of the three vertices 1.55% of EPA.

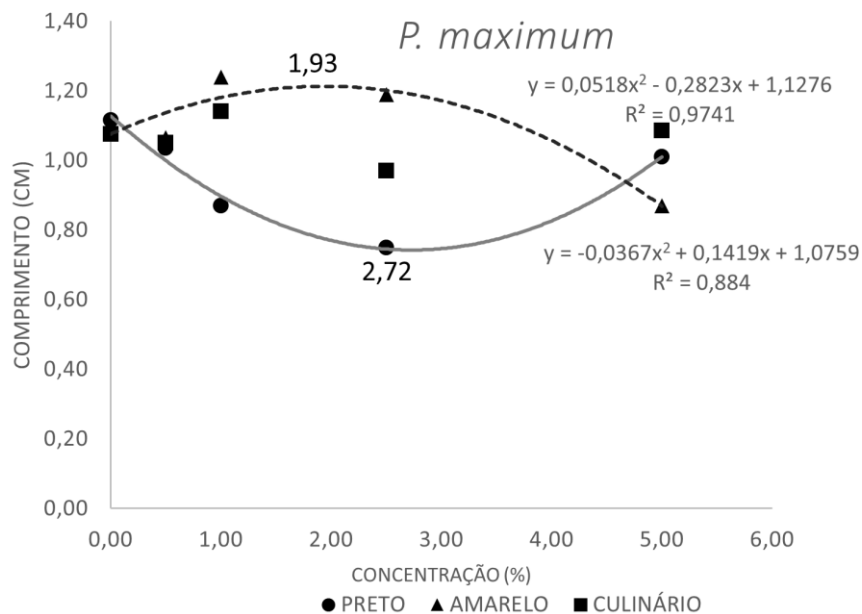
Figure 4

Percentage of germination of Panicum seeds (Panicum maximum cv Miyagui) in relation to the concentration of Pyroligneous Extracts.

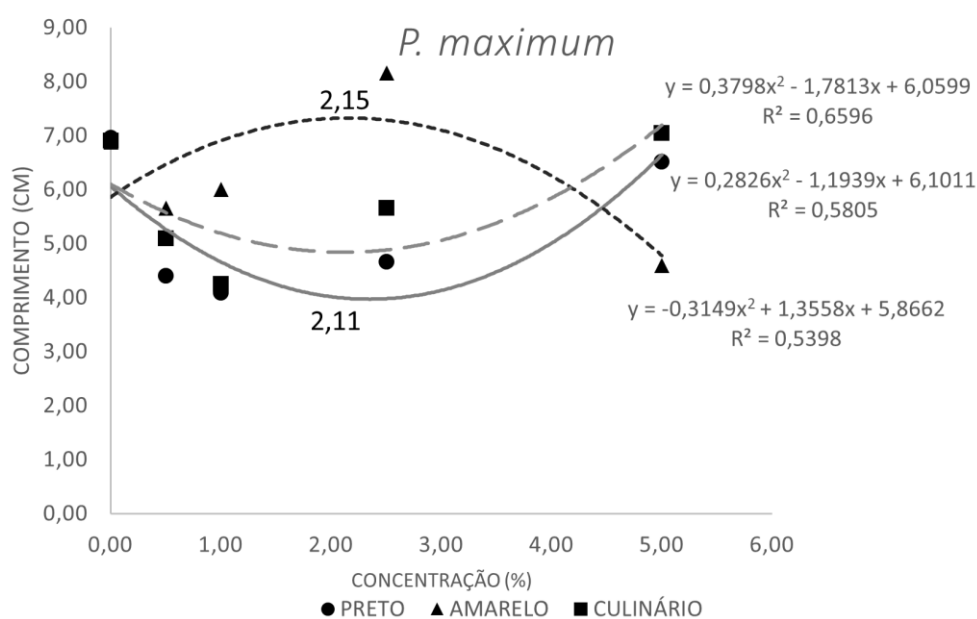


**Figure 5**

Development of the apical meristem of *Panicum* seeds (*Panicum maximum* cv Miyagui) in relation to the concentration of Pyroligneous Extracts.

**Figure 6**

Development of the root meristem of *Panicum* seeds (*Panicum maximum* cv Miyagui) in relation to the concentration of Pyroligneous Extracts.



The main responses observed for the species *P. maximum* cv Miyagui were in relation to the treatment with EPA and EPP. For the length of the root apical meristem and shoot apical

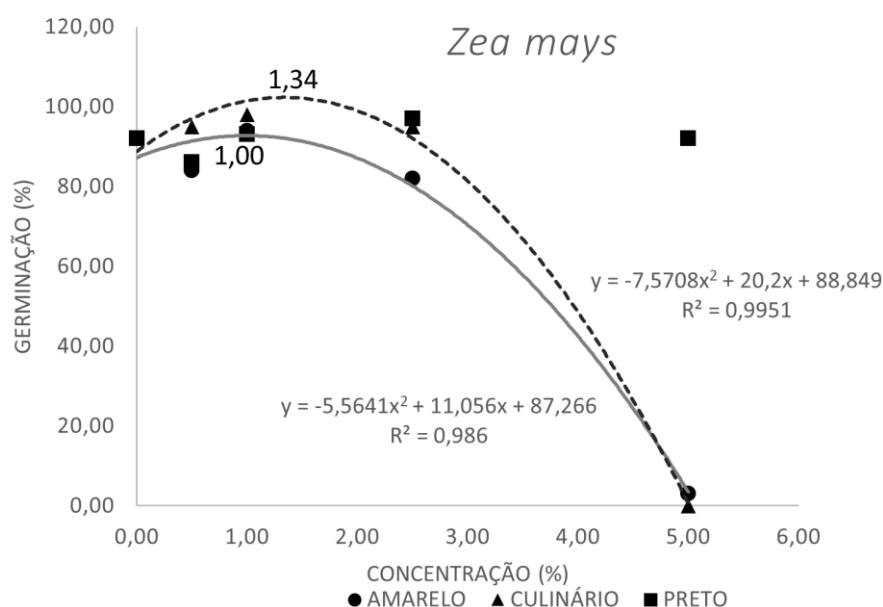


meristem, an increase of 18.26% and 24% was observed when the concentration of 2.5% and 1.0% was used, respectively. For the germination percentage, there was an increase of 17.57% when the treatment with EPP at a concentration of 5.0% was used.

For corn, the concentration obtained through the averages of the parabola behaviors was 1.88% for EPA and 1.33 for EPC (Figures 7, 8 and 9). Above the concentration of 2.0%, the plants began to react negatively to the treatment, mainly inhibiting seed germination (Figure 7).

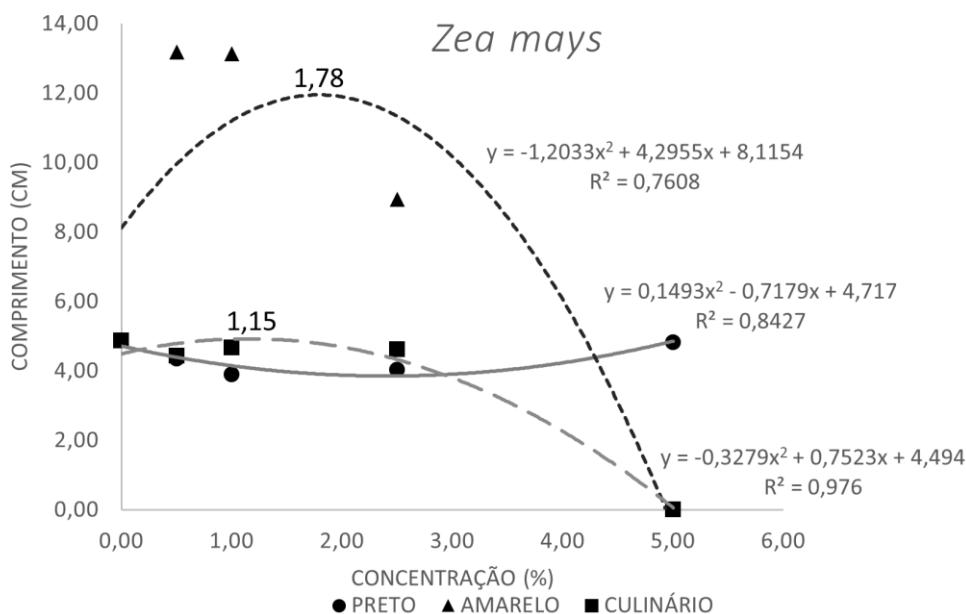
Figure 7

Percentage of germination of corn seeds (Zea mays L.) in relation to the concentration of Pyroligneous Extracts.

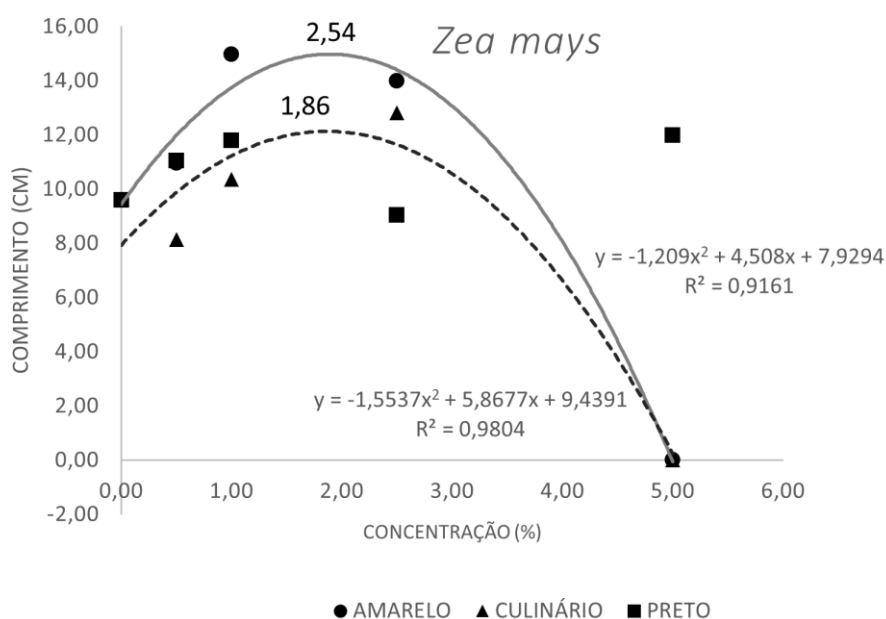


**Figure 8**

Development of the apical meristem of corn seeds (*Zea mays* L.) in relation to the concentration of Pyroligneous Extracts.

**Figure 9**

Development of the root meristem of corn seeds (*Zea mays* L.) in relation to the concentration of Pyroligneous Extracts.



For the evaluations, the main results were identified through treatment with EPA, at different concentrations. Among the results observed, we can highlight an increase of



approximately 56.20% in the length of the apical meristem of the root of *Z. mays* L. at a concentration of 1.0% EPA. In relation to the apical meristem of the stem, the same behavior can be observed, where the species had an increase of 182.33% with the use of EPA at a concentration of 0.5%. However, throughout the evaluation of the germination percentage, it is possible to identify that there were no significant results.

The use of EPA and EPC at their maximum concentrations inhibited the evaluation of the three characteristics assessed in the species *Z. mays* L, results that distinguish them from other species.

In general terms, only EPA generated significant responses that, in the case of corn, increased the development of the root meristem by 35.9% (1% EPA) and by 64.5% for the apical meristem of the stem (0.5% EPA), but did not produce effects on germination and even inhibited it at a dilution of 5% EPA. The same was verified for EPC for the species. As for *Panicum* and *Brachiaria*, different effects were observed in relation to the dilutions with corn. In *Brachiaria*, the lowest dilution of EPA generated an increase of 29.4% in germination, but the effects on the development of roots (15.4% at 2.5% EPA) and stem (19.3% at 1.0% EPA) occurred at higher dilutions. This behavior in relation to *Brachiaria* was 9.03% increase for roots (2.5% EPA) and 31.2 for stem (5% EPA). The other extracts and their dilutions did not result in satisfactory effects.

Regarding the specific conditions and the regression study, it was obtained that: For the germination percentage, the EPP in cv Basilisk, despite being favored by increasing the dosage, did not allow regression adjustment. The same was verified with corn. For cv Miyagui, the germination percentage of its seeds was favored at the dose of 3.59% (vv⁻¹). For this same characteristic, the EPA generated toxicity in Basilisk, but promoted an increase in Miyagui (0.59% vv⁻¹) and in corn (1.34% vv⁻¹), despite having depressed germination with increasing the dose. On the other hand, the EPC generated a depressive effect in Basilisk (3.7% vv⁻¹) and had a favorable effect at low doses for Miyagui (without allowing regression adjustment) and corn (depressive with increasing the dose).

For the development of the apical meristem, EPP promoted a positive effect at low doses (0.5% vv⁻¹) but without allowing regression adjustment in Basilisk. For Miyagui, it exerted depression in this characteristic (2.72% vv⁻¹) but not at its highest dose. There was a small depressive effect for corn. With EPA, an increase in the response was observed with increasing doses in Basilisk. For Miyagui (1.93% vv⁻¹) and corn (1.78% vv⁻¹), the development of the apical meristem was favored, but this was depressed with the highest doses. With EPC, there was favoritism, at low doses, for Basilisk (1.0% vv⁻¹) and corn (1.15% vv⁻¹). For corn, there



was a depressive effect with increasing doses. However, for Basilisk and Miyagui, it was not possible to obtain regressive adjustment.

For the development of the root meristem, EPP had a depressive effect for Basilisk ($2.69\% \text{ vv}^{-1}$), Miyagui ($2.11\% \text{ vv}^{-1}$) and corn. On the other hand, EPA promoted the development of the root meristem in Basilisk ($2.5\% \text{ vv}^{-1}$) but without regression adjustment. For Miyagui ($2.15\% \text{ vv}^{-1}$) and corn ($2.54\% \text{ vv}^{-1}$) they were favored at low doses but depressed the expression of this characteristic with the increase of the dosage for both cases. With EPC, a depressive effect for the root development was also obtained in Basilisk ($2.45\% \text{ vv}^{-1}$) and Miyagui ($2.5\% \text{ vv}^{-1}$) but not in corn ($1.86\% \text{ vv}^{-1}$) although a depressive effect occurred with the increase of the dosage.

4 DISCUSSIONS

In the germination process, seed imbibition can be considered the main factor compared to light, temperature and relative humidity, since it can accelerate the germination process by metabolic reactivation and remobilization of cotyledonary reserves, in order to be assimilated and promote embryonic growth (Guimarães *et al.*, 2013). Despite the effects observed with the same imbibition time (16 h) for the treatments with pyroligneous extract solutions, it can be considered that the treatments did not act in a similar way in relation to the seeds studied.

The seed soaking process, in addition to softening the teguments and activating enzymes to generate new structures, must occur in the presence of oxygen in order to efficiently convert the reserve material into energy molecules used in the development process (Guimarães *et al.*, 2013). This can be understood as the metabolic transformations generating an increase in the levels of soluble sugars and a reduction in the levels of starch, similar to what happens with reserve proteins (Dantas *et al.*, 2008). As the oxygen level decreases, the energy production rates will decrease, even compromising the development of the embryo. Thus, despite the use of the same soaking time (16 h) for different seeds (sizes), this may not be considered harmful between *Brachiaria* and *Panicum* in relation to corn.

For *Brachiaria decumbens*, for example, the average seed weight is 0.0083 ± 0.00108 g. For the species, when classified as large, medium and small, negative asymmetry is observed, that is, the average and median values are to the left of the modal value. And, in relation to the amplitude, greater variability is obtained for small seeds compared to large ones. It is important to remember that seed size is a characteristic related to imbibition. Small seeds acquire more water compared to large seeds due to the greater contact area per mass moisture content (Araldi



et al., 2013). For corn seeds, their weight can vary, for example, between 0.383 and 0.210 g for flat seeds and 0.396 to 0.208 g for round seeds (Vasquez *et al.*, 2012).

As a reminder, germination behavior can be understood in three stages. The first begins with the absorption of water by the seed until it is fully turgid. The second occurs with the activation of metabolic processes (respiration rate, metabolism of substances, among others) and the third, protrusion of the radicle and elongation of the aerial part (Salomão, José & Rodrigues, 2023).

For *Brachiaria brizanta* cv Marandu, although the seed coat (glume, palea and lemma) is quite dehydrated in order to retain water and protect the embryo inside, these structures do not represent an impediment to the movement of water, which can occur continuously in the case of intact seeds. Comparatively after 12 hours of soaking the amount of water is greater than that of naked seeds and is 5% greater in 30 h (Câmara & Stacciarini-Seraphin, 2002).

For *Panicum maximum* cv Tanzânia, when soaked under aeration, the seeds reached the second stage of germination in approximately 43 hours of soaking and its completion (stage three) after 50 hours. This behavior was different when compared to the cultivars Mombaça (19.56 h) and Milênio (24.40 h). It is worth noting that the hydration speed decreases in relation to the initial water potential, among other factors (Dutra, 2008). For corn, under ideal conditions, the soaking time can take from 8 to 16 h (Marcos Filho, 2018). Regarding watermelon (*Citrullus lanatus* Thunb. cv Chaleston Gray), the 12-h period generated the highest percentages of emergence (81.25%) of seedlings 12 days after sowing in relation to the other periods evaluated (0, 24, 48 and 72 hours; average of 65%). The authors comment that periods greater than 49.80 hours and less than 134.70 hours positively affected the quantitative growth characteristics of watermelon seedlings (Guimarães *et al.*, 2013).

In general, treatments with EPA generated atrophic protruding roots and, with the increase in its concentration, total impairment of the root system and the embryo.

In general terms, longer periods of imbibition generate greater development of shoots and roots (Guimarães *et al.*, 2013), and since the period for this study was the same (16 h), the effects on greater development or not of germination rates and meristematic structures can be related to substances that promote or inhibit the development stimuli present in the extracts. In the different concentrations and types of extracts studied, both promotion and embryo development can be observed (Figure 2; Figure 4, for example) or not (EPP in corn – Figure 7, for example).

For EPC, the impairment in germination and embryonic development may be associated with the osmoconditioning suffered by the embryo since this product has a salty taste. In the



literature, germination impairment is reported in relation to osmoconditioning with potassium nitrate (Salomão, José & Rodrigues, 2023).

Some studies reported in the literature can also show contradictory results. In a study carried out by Lourenço *et al.* (2021), the use of EP was concluded as a germination stimulator for the species *B. brizantha* cv Piatã, through the immersion of seeds for 18 hours in 5% EP. Kumi (2023) recorded that there was no significant improvement in the morphological characteristics of the *Brachiaria species* evaluated with the use of EP. Figueira *et al.* (2021) concluded that the use of EP on Mombaça grass has a herbicidal effect, delaying its development, and Barbosa *et al.* (2023) recorded significant increases in stem diameter, number of leaves, and dry matter of the aerial part of *Brachiaria humidicola* with the use of EP.

Seed pre-soaking is used in a variety of crops (sorghum, beans, mung, corn and wheat) as a technique to obtain a more uniform, fast and vigorous emergence. And such condition can positively influence the harvest time and its productivity (Guimarães *et al.*, 2013). Knowledge of the factors that influence seed germination represents the possibility of developing technologies to improve the percentage, speed and uniformity of germination, in order to produce more vigorous plants and minimize costs (Dantas *et al.*, 2008).

It is important to emphasize that the evaluation of the initial and final moisture content of the seeds is important in characterizing the behavior of the effects promoted in a dose-response experiment. Studies related to the imbibition curve are also necessary to characterize the germination phases and the time required for water absorption in different seeds.

5 CONCLUSION

The use of different pyroligneous extracts promoted varied effects regarding the promotion or even toxicity of the variables studied in relation to the seeds. In general, for *Brachiaria decumbens* cv Basilisk, seed germination was depressed with the use of the extracts (EPP, EPA and EPC), and they promoted the development of the apical meristem but with a depressive effect on the development of the root meristem in the case of EPP and EPC, however not with the use of EPA.

For *Panicum maximum* cv Miyagui, the use of extracts favored germination but with a depressive effect as the doses increased. The same was true for the development of the apical meristem, but without regressive adjustment in the case of EPC. In the case of the root meristem, a depressive effect was observed with the use of EPP and EPC but not with EPA.

For corn seeds (*Zea mays* L.), EPP did not allow regression adjustments regarding



germination percentage, indicating varied effects. For this characteristic, favorable effects were obtained with the use of EPA and EPC at low doses, with depression in development with increasing concentrations. Regarding the development of its apical meristem, with the regression study, depression was observed (EPP and EPC) or not (EPA). In the expression of the root meristem, there was promotion in its development with the lowest doses of the studied extracts.

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