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DIGITAL AGRICULTURE:
THE NEW FRONTIER

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WEB 8.0 PG

Fluminense Federal University

School of Engineering

Postgraduate Program in

Biosystems Engineering

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2023

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Marcos Alexandre Teixeira

Daiane Cecchin

Cristina Moll Hüther

Carlos Rodrigues Pereira

Fábio Ferreira Dias

Guilherme Donagemma

Róberson Machado Pimentel

Thelma de Barros Machado

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Support:

Introduction

The Workshop on Biosystems Engineering (WEB) is an academic event that stated tacking our internal research and students, focused in to present and discuss the research results of the Biosystems Engineering Master Program (PGEB).

Over the years, the event have grown, expanding far over the boundaries of the Fluminense Federal University, bringing close many people and researcher interested in the area of Environmental Sciences. For this 8th edition, bringing invited speakers and lectures from other states. Due to the Worldwide COVID-19 pandemic situation, the event was again held on-line been broadcasted on the YouTube platform.

This year's edition main theme was: "digital agriculture: the new frontier" (Agropecuária Digital: a nova fronteira in Portugese), being held from the 08th up to 10th November 2022.

In total there were almost 150 inscriptions, been held: 6 lectures, 3 short courses, 2 round tables ("Digital Livestock: The New Frontier" and "Digital Agriculture: The new frontier"), all accepted papers were invited to submit an online presentation, available as a playlist as a virtual discussion Forum (35 abstracts accepted) available at the PGEB Youtbe Channel at: https://www.youtube.com/c/PGEBUFF/videos

The WEB, as known, had consolidated itself as one of the main scientific events of UFF, even in time of COVID-19 pandemic, integrating students, from graduated, undergraduate or even alumni; as well as Professors from several different academic areas, from UFF and from other institutions worldwide.

The Organizing Committee

Scientific Committee Evaluation

The Scientific Committee took the role to evaluate the presented abstracts and here we bring forward the best evaluated papers of the event (with some ties in tow categories), as follows:

- Agricultural Systems:

  1st Places – Traceability of organic agricultural products for small producers - a review. Main author: Ana Caroline Lopes Maria;

  1st Places – School gardens: creation of a model school at the Vinicius de Moraes Municipal Child Education Unit (UMEI) . Main author: Gabriela Martins Corrêa;

  2nd Place – Evaluation of the influence of soils with different levels of natural fertility on the growth of bean (*phaseolus vulgaris*) and creole maize (*zea mays*) crops. Main author: Jéssica Raposa Rocha; and

  3rd Place – Analysis of chlorophyl a fluorescence in different varieties of shiso. Main author: Julia Ramos de Oliveira.

- Environmental Management:

  1st Place – Geospatial analysis of fires in the tropical region: a case study in Rio de Janeiro state. Main author: Renato Brito Neves da Silva;

  2nd Place – Bibliometric analysis of the relative sea level in Rio de Janeiro state. Main author: Elizabeth Santos Pereira; and

  3rd Place – Monitoring of environmental systems with neural networks for fire detection. Main author: Leandro Pereira Bernardo.

- Natural Systems:

  1st Place –.Edaphic macrofauna as an indicator of environmental quality in a segment of the atlantic forest. Main author: Lorena de Almeida Coimbra;

  2nd Place – Atmospheric experimentation with low-cost radiosonde attached to a drone. Main author: David Christian de Lima Ferreira;

  3rd Places – Industry carbon emissions reduction indicators by 2050 cement manufacturer in Brazil. Main author: Josiane da Silva Torres Machado; and

  3rd Places – The orchid reserve in the Massambaba sandbank, Arraial do Cabo (Rj): natural ecosystems, environmental degradiation and colonization by *casuarina equisetifolia*. Main author: Leonízia Valdeci de Melo.

The presentations of the works can be assessed in the Yotube Playlist: https://www.youtube.com/@PGEBUFF/playlists.

Congratulations to all researchers.

Summary

Legal Disclaimer (responsibility for the abstracts)

All authors as solely responsible for the abstracts, authenticity, technical aspects, writing and copyright presented and included in this publication, exempting the members responsible for the organization of the VIII Workshop on Biosystems Engineering (WEB 8.0) from any responsibility of this nature. Abstracts sent that did not meet the formatting requirements were disregarded (the organization allowed small changes for editorial adjustments).

Abstracts Section

AGRICULTURAL SYSTEMS

AGRICULTURE 4.0: TECHNOLOGIES FOR AUTOMATION IN THE FIELD

Frederico Pires Pinto [1], Hyanara Evangelista Oliveira [2], Daiane Cecchin [2], Juliana Lobo Paes [3]

[1] Universidade Federal de Tocantins – UFT (frederico@ufrrj.br)
[2] Universidade Federal Fluminense – UFF
3 Universidade Federal Rural do Rio de Janeiro - UFRRJ

Abstract

Agriculture is currently incorporating Industry 4.0 technologies, such as the Internet of Things (IoT), Artificial Intelligence and Big Data. Through the use of these technologies, it is possible to optimize agricultural production with significant real gain, minimize environmental impacts and reduce waste. The implementation takes place through the use of resources such as algorithms, sensors, computational modeling, communication networks that generate a cycle of input, processing and output of data. The objective of the present work was to carry out a survey of publications referring to technologies in the field in recent years. To this end, a bibliometric review was carried out on the subject, with data collection from the Scopus database, then the data were analyzed with the aid of the VOSviewer software and the generation of maps of the terms in co-occurrence, most cited authors. The results obtained through data collection were represented on maps, allowing the identification of the most cited words in the publications, the authors with the highest number of research carried out in the area, graphs are also presented with the publication rates per year, which countries were responsible for the publications and the subareas of publications. It is concluded that the rate of publications of scientific works associated with the Internet of Things, Artificial Intelligence and Big Data focused on the field is still low, but there is a great perspective of increase, because gradually over the years the numbers of publications have been increasing regarding this area of study.

Keywords: Internet of Things, Artificial Intelligence, Big Data.

INTRODUCTION

With the development of computing, electronics and process automation in the 20th century, Agriculture 3.0 emerged, which adopted computer programs and robotic techniques to improve field operations (ZHAI et al., 2020). Currently, agriculture has evolved more and more and has added several technologies such as the Internet of Things (IoT), Artificial Intelligence (AI) and Big Data, among others that are already present in the field, helping to move towards what they call Agriculture 4.0. These technologies are able to significantly optimize the efficiency of agriculture, minimizing environmental impacts and reducing waste.

Systems such as irrigation control, use of drones, fertilization control, humidity monitoring, machine monitoring among other controls, once interconnected, can bring not only savings in financial resources, but also in natural resources, as the communication between these equipment can assist in greater precision in the management and monitoring of productive areas (BARROS; LEUZINGER, 2019; CORALLO, LATINO & MENEGOLI, 2020, SANTOS et al., 2022).

The technology applied in this “new” agriculture is supported by a set of elements ranging from algorithms, sensors, computational modeling and even communication networks that generate a cycle of input, processing and output of data. Thus, the objective of this work was to carry out a bibliometric review on the use of agriculture 4.0.

MATERIALS AND METHODS

The present study is bibliographic in nature, presenting data and records through a systematic literature review. The database used was Scopus, the searches were done with the combination of the keywords: Internet of Things AND Agriculture 4.0 AND Data AND Smart Farm. Studies published in English were considered. The time window adopted was from 2016 to 2022.

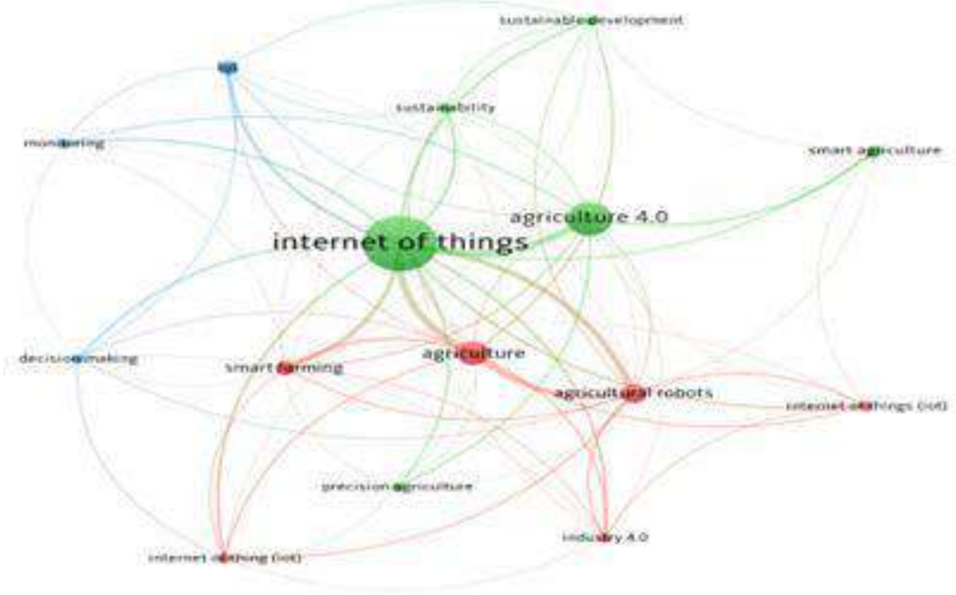
The recovered files totaled 29 (twenty-nine) publications, which were later analyzed with the help of the VOSviewer Software to create the maps. The topics adopted for the analysis were the words with the highest occurrence and in the most cited authors.

RESULTS AND DISCUSSION

With the help of the VOSviewer software, the mapping of keywords related to the survey proposed in the work was carried out. The searches were concentrated in articles and aimed to find the terms with the highest occurrence.

By default, a minimum of five repetitions was defined in the article so that the map could be created. Through the grouping performed by VOSviewer, it was possible to identify that three main groups were formed, each with a different related color, as shown in Figure 1. These colors group the terms that are most often cited in the same paper.

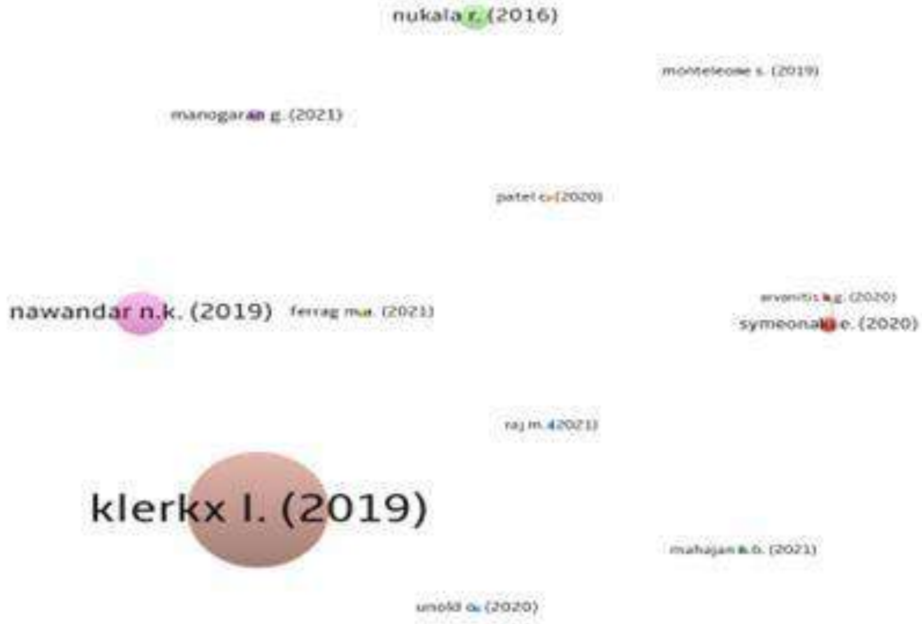
Figure 1: Map of co-occurring terms in the titles and abstracts



From the map, it was possible to identify the connection between the terms in the different articles. Three clusters (groups) were identified, with group one (red) containing 6 words (agricultural robots; agriculture; industry 4.0; internet of thing (iot); internet of things (iot); and smart farming) that appear at least five times each in the same article. Group two (green) also has 6 grouped terms (agriculture 4.0; internet of things; precision agriculture; smart agriculture; sustainability; and sustainable development) that also fit this criterion. Finally, group three (blue) which has three items (decision making; iot; and monitoring).

The term with the highest number of appearances in the different articles is "internet of things", presented the largest circle demonstrating its greater occurrence among the searched terms. It is important to note that in this map the term appears in another form, abbreviated (iot), in the plural (internet of things (iot)) and in the singular (internet of thing (iot)), increasing this number even more. Another point analyzed was the occurrence of citations. Among the articles analyzed, the most cited author was Klerkx (2019) as can be seen in Figure 2.

Figure 2: Map of the most cited authors.



The Klerkx study (2019) carries out a review of social science on agriculture 4.0, demonstrating the new contributions and a future research agenda for the topic.

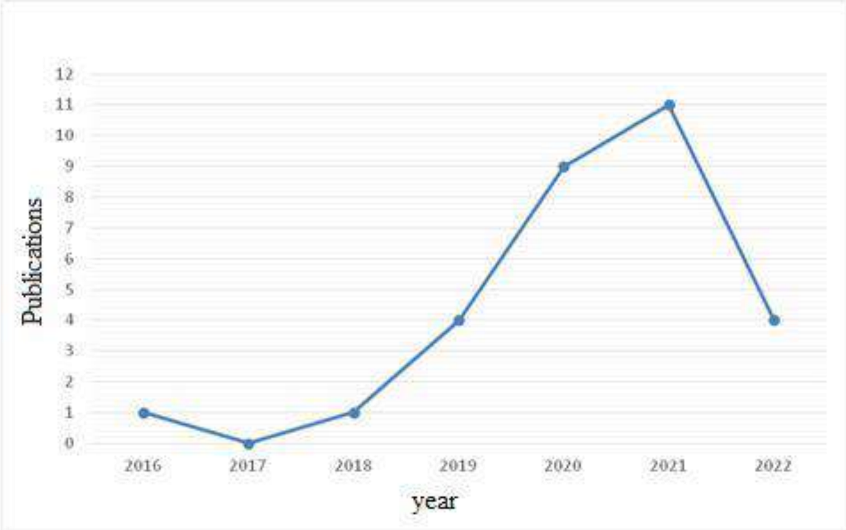
Analyzing the topics covered in the articles studied, it was possible to verify the authors' objectives and divide them into sub-areas, namely: Artificial Intelligence (AI and Big Data in the Field Using IoT for Data Collection (Ouafig *et al.;* 2022) Microservices Architecture (Microservices and cloud focused on livestock (Mateo-Fornés et al., 2021). Integration between field facilities (Symeonaki, Arvanitis, Piromalis, 2020)); Automated detection and control systems (such as: cow health monitoring system (Unold et al., 2020; Feng et al., 2022) automation system for pig farming (Symeonaki et al., 2022; Netinant, Niratsoke and Rukhiran, 2021); automation in irrigation (Mohammed et al., 2022; Nawandar & Satpute, 2019)); Literature review (Impact and challenges for IoT (Singh et al., 2022); IoT as a solution to problems in the field (Gagliardi et al. (2021); improvements to properties (Kumar et al., 2021, Micle et al., 2021; Cuong et al., 2020; Angeloni, 2020) among others). and Information Security (Intrusion detection based on distributed denial of service attack in agriculture 4.0 (Ferrag et al., 2021); Security model for IoT in the field (Patel & Doshi, 2020)).

Based on the papers analyzed and classified, the subarea that had the highest percentage of articles was “Bibliographic Review” with approximately 48.28% (14 articles) published. The sub-area “Automated detection and control systems” was second with 20.69% (6 articles) followed by “Microservices Architecture” with 13.79% (4 articles), “Artificial Intelligence and algorithms” with 10.35% (3 articles) and “Information Security” with 6.89% (2 articles), respectively.

Taking into account the general objective of the works, it is also possible to divide them according to their applicability (theoretical or practical). In approximately 55.17% of the articles the focus is theoretical (state of the art or proposition of strategies for use in the field) while in the other 44.83% the objective is practical (prototypes or tools for application in the field).

For a better visualization of the data regarding the publications carried out on the subject in the defined time window, graphs were developed for the representation. Regarding the period of publications, they are shown in figure 3 below.

Figure 3: Publications x Year



It can be observed that from 2018 to 2019 there was a considerable increase in the number of publications, which continued to rise in subsequent years, pointing to a peak in 2021, in 2022 a reduction was recorded, but it may be due to time, as the analysis was carried out until the end of the year. month of June, this value may increase again when considering the papers that have been or will be published by the end of 2022.

Regarding the origin of publications, it was observed that the country with the highest number of publications in the research area is India with a total of nine publications in this defined period, followed by Greece with four publications, with a total of three publications. Australia and the United States, followed by Algeria, Brazil, China and Italy each with two publications and finally Canada and Cyprus with a single publication each.

Regarding the subareas of publications, Computer Science had the highest percentage: 31.7% (22 publications), followed by Engineering with 15.9% (10 publications), Agriculture and Biological Sciences with 14.3% (9 publications), Physics and Astronomy with 5 publications equivalent to 7.9%, Biochemistry, Genetics and Molecular Biology together with Chemistry have 4.8% each with 3 publications, Chemical Engineering, Decision Sciences, Energy and Mathematics have the percentage of 3.2% each with two publications and finally the percentage of Others has 7.9% (5 publications).

CONSIDERATIONS

Evolutions in agriculture caused a drastic modification in the way of working in the field, where it was traditionally known for its manual work, gave way to technologies. Increasingly, processes are being automated and cutting-edge technologies are developed, providing improvements in the production chain and in the distribution of products through a more productive and cost-effective method. Technologies are crucial to further evolving the field, but much remains to be done before these innovations are accessible to all. Development of cheaper technologies, training people and increasing the communication network are examples of evolutions that still need to happen so that it has greater adoption and that all farmers can produce more while consuming less resources and areas. From this work, it became evident that in the field of technologies in the field, the Internet of Things is the most frequent and that interest in the topic is growing, especially in recent years.

PRESENTATION: https://youtu.be/rC7CyTVCjsk

REFERENCES

BARROS, L.S.C.; LEUZINGER, M.D. O uso de drones como instrumento para a conservacao da biodiversidade no Brasil. **Revista de Direito Internacional**, v. 16, n. 2, 2019.

CORALLO, A.; LATINO, M.E.; MENEGOLI, M. Agriculture 4.0: How Use Traceability Data to Tell Food Product to the Consumers. In: **2020 9th International Conference on Industrial Technology and Management (ICITM)**. IEEE, p. 197-201. 2020.

KLERKX, L.; JAKKU, E.; LABARTHE, P. A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agendaNJAS **- Wageningen Journal of Life Sciences,** 2019.

LIU, Y. et al. From Industry 4.0 to Agriculture 4.0: Current status, enabling technologies, and research challenges. **IEEE Transactions on Industrial Informatics**, v. 17, n. 6, p. 4322-4334, 2020.

SANTOS, J. et al. Spectral responses at visible and near-infrared wavelengths of soybean plants to fungicides. **Ciência Rural.** v. 52. 2022.

ZHAI, Z. et al. Decision support systems for agriculture 4.0: Survey and challenges. **Computers and Electronics in Agriculture**, v. 170, p. 105256, 2020.

ANALYSIS OF ARUNDO DONAX L. CROP FIRST YEAR GROWTH IN THE STATE OF RIO DE JANEIRO

Luis Damian Rodriguez [1], Róberson Machado Pimentel [2], Adriana Elisabet Confalone [3], Carlos Rodrigues Pereira [4]

[1] Graduate Program in Biosystems Engineering - PGEB at Federal Fluminense University (UFF), Brazil (lrodriguez@id.uff.br)
[2] Federal Fluminense University (UFF), Medical Science Center, Veterinary Faculty
[3] Universidad Nacional del Centro de la Provincia de Buenos Aires, Facultad de Agronomía, 7300, Azul, BA, Argentina
[4] TER/TCE/UFF , Niterói, RJ, BR, (21) 2629 5362

Abstract

The impact of fosil fuels on the generation of greenhouse effect gases has intensified studies on new sources of renewable energy, such as energy crops. *Arundo donax* L., known in Brazil as *Cana-do-reino,* is one of the most promising crops for energy production due to its fast growth, high productive potential and capacity to grow in different types of soils and climatic conditions. The objective of this paper is to evaluate the implantation stage of *Arundo donax* L. crop growing in the centre region of Rio de Janeiro under different conditions applying 4 treatments with fertilization of N and P (T1 and T3), without fertilization (T2) and the same as in T4 but the latter without weed control during the growth period. The crop was implanted with two densities (1 and 2 plants.m^{-2}) in March 2022 using rhizomes. Throughout the growth cycle, measurements of Foliar Area Index were performed, and at 174 days after emergence, the aerial part of the crop was harvested. In the first cycle, treatments implanted with a greater density doubled biomass production (3000 kg.ha^{-1}) in relation to the crop implanted with a lower density, without significant differences among T1, T2 and T3; whereas, in T4 yield was significantly lower. These differences are substantiated on a greater value of the Leaf Area Index.

Keywords: biomass, energy crops, ecophysiology, agrometeorology

INTRODUCTION

The growing energy demand has delved into the exploitation of non-conventional fossil fuels, becoming one of the main causes of climatic change (IPCC, 2014). In this context, the impact of fossil fuels in the generation of greenhouse gases (GEI) has pushed the study of new sources of renewable energy , among them, energetic crops, since stopping global warming is the main environmental challenge for mankind.

Arundo donax L. (*Cana-do-Reino*) is an Asian herbaceous plant which belongs to the *Poaceae* family, being one of the most promising crops for energy production, mainly due to its high productive potential and the lignocellulosic nature of its biomass, with a calorific value of more than 4000 kcal.kg^{-1} *M.S* (CANO RUIZ *et al*., 2020). It is also characterized by its rapid growth, tolerance to adverse environmental conditions and ability to grow in different types of soils and climatic conditions (MEHMOOD *et al*., 2017).

Once planted, this crop can give yields for more than 15 years, being able to reach 40 $ton.ha^{-1}.year^{-1}$ in the absence of water and nutritional restrictions, starting from the second year in the Mediterranean region of Europe (COSENTINO *et al*., 2016).

In the northern hemisphere, it is a species used for the production of biomass for bioenergy (CURT *et al*., 2017) due to its high growth rates and high water use efficiency, which makes it a suitable species for bioenergy generation (TRIANA *et al*., 2014).

The objective of this work was to evaluate the establishment stage of the *Arundo donax* L. (*AD*) crop growing in the central region of Rio de Janeiro, under different growth conditions.

MATERIALS AND METHODS

The experiment was implemented at the Fazenda Escola de Cachoeira de Macacu (FECM), located in the Rio de Janeiro State, Brazil (latitude: 22°31' S; longitude: 42°42' W, altitude: 30 m), with rhizomes (R) obtained from reedbeds in Brasilia DF.

The experimental design was entirely randomized (DIC), consisting of four treatments (growth conditions). In T1 and T3 the soil (*Gleissolo*) was fertilized with 100 $kg.ha^{-1}$ of Nitrogen (N) and 20 $kg.ha^{-1}$ of Phosphorus (P), while in T2 the soil was not fertilized, imitating the real conditions of the environment, as in T4, without fertilization and without weed control during the whole period.

In the first year of cultivation, T1 and T3 were similar, since, from the second cycle on, T1 and T2 will be irrigated. In the secondary plots, of 9 m^2 (3x3),sprouted rhizomes of *AD* were planted in March 2022, at two densities: 1 $pl.m^{-2}$ (R1) and 2 $pl.m^{-2}$ (R2).

Once the crop was planted, Leaf Area Index (LAI) measurements were performed using the destructive method and empirical calculation (MOURA PEREIRA *et al*., 2015), where length and width of leaves of two plants per subplot were measured, and subsequently these values were multiplied by the factor 0.75 (L*W*0.75).

Finally, the LAI value obtained in each subplot was determined from the average calculated between the two measured plants. The observed LAI values were adjusted to a Gaussian equation (RODRIGUEZ *et al*., 2021). At 174 days after emergence, the aerial part was harvested with shears in an area of 9 m^2 per subplot to determine the dry matter produced.

RESULTS AND DISCUSSION

During the first growth cycle, the treatments planted at the highest density, with the exception of T4, obtained the highest values of

aerial biomass produced, exceeding 3000 $kg.ha^{-1}$ of dry matter (Table 1). For the four treatments, the reduction in density produced a decrease of more than 40 %. The results show that in the first year no significant differences were found between T1, T2 and T3, while in T4, a significant reduction in dry matter production was observed.

Table 1: Total aerial biomass (dry matter in kg.ha^{-1}) obtained for each treatment: combination of growth conditions (T1, T2, T3 and T4), and two planting densities, 2 and 1 pl.m^{-2} (R2 and R1) in the first year.

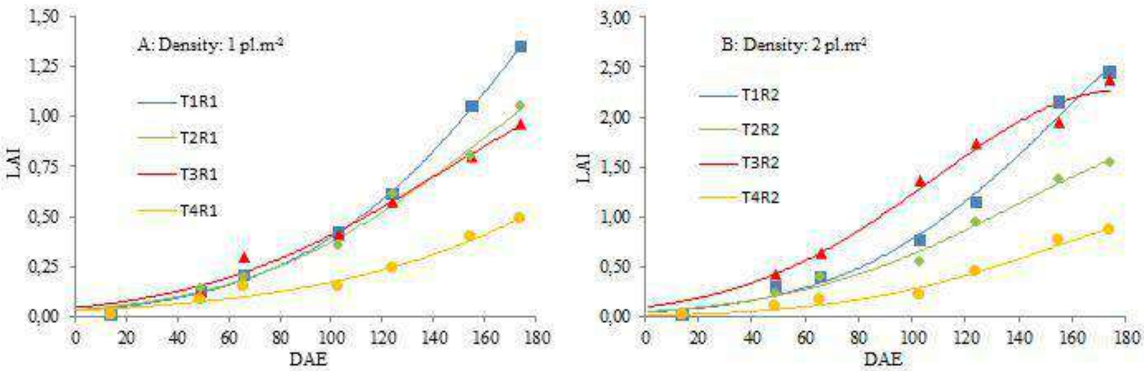
Treatments	Aerial biomass (kg.ha^{-1})	Tuckey Test
T4 R1	361,61	A
T4 R2	772,22	A B
T3 R1	1341,7	A B
T1 R1	1821,12	A B C
T2 R1	2179,56	B C D
T3 R2	3142,65	C D E
T2 R2	3518,11	D E
T1 R2	3930,44	E

** Values in columns followed by the same letter do not differ by tuckey test (P <0.05)*

Biomass production values were lower than those found in Argentina during the first growth cycle (RODRIGUEZ *et al*., 2021), and this is because the crop grew in the autumn-winter months, while in Argentina the The crop was sown in spring, lasting 289 days. The results are in agreement with ANGELINI *et al*. (2009), where they determined that biomass production is very low in the first year.

The evolution of the IAF in the four treatments, in both seeding densities, was adjusted to the Gaussian equation (r2 ≥ 0.987).

Figure 1: Temporal evolution of leaf area index (LAI) as a function of days after emergence (DAE) in the first growth cycle for the four treatments, planted at a density of 1 pl.m^{-2} (A) and 2 pl.m^{-2} (B). The symbols represent the mean observed values and the continuous lines the adjustment model..



At the lowest density (Fig. 1A), T1 had the highest exponential growth rate, reaching a value of 1.4 at harvest. T2 and T3, planted at a density of 1 pl.m^{-2}, reached a LAI value similar to the harvest (1.05 in T2 and 0.97 in T3). Regarding T4, the LAI obtained at 174 DAE was 0.5. At the highest density (Fig. 1B), the LAI obtained in T1 and T3 at harvest was 2.4, while T4 reached an LAI of 0.87. During the first days after emergence, the crop showed a low growth rate, also observed in the first year in Argentina (RODRIGUEZ *et al*., 2021).

Finally, it can be seen that in this first growth period, the four treatments did not reach the maximum LAI value, demonstrating the adjustment to the Gaussian equation that after harvest the LAI continued to increase, without being able to observe the form Gauss bell, characteristic in the evolution of LAI. VOLTA *et al*. (2016) point out that the first year of growth is the year of implantation of the crop.

CONSIDERATIONS

In the first year, the treatments planted at the highest density doubled the biomass production, in relation to the crop planted at the lowest density, being explained by the higher LAI values. We also concluded that the presence of weeds during the implantation period negatively affects crop growth rate.

PRESENTATION: https://youtu.be/UpCvdKolrEU

REFERENCES

ANGELINI, L. G.; CECCARINI, L.; NASSI O DI NASSO, N.; BONARI, E. Comparison of *Arundo donax* L. and Miscanthus x giganteus in a long term field experiment in Central Italy: Analysis of productive characteristics and energy balance. **Biomass and bioenergy**, Amsterdã, Holanda, v. 33, n, 4, p. 635-643, abr. 2009.

CANO-RUIZ, J.; SANZ, M.; CURT, M. D.; PLAZA, A.; LOBO, M. C.; MAURI, P. V. Fertigation of *Arundo donax* L. with different nitrogen rates for biomass production, **Biomass and Bioenergy**, v. 133, 105451, 2020.

COSENTINO, S. L.; PATANÉ, C.; SANZONE, E.; TESTA, G.; SCORDIA, D. Leaf gas exchange, water status and radiation use efficiency of giant reed (*Arundo donax* L.) in a changing soil nitrogen fertilization and soil water availability in a semi-arid Mediterranean area. **European Journal of Agronomy**, Amsterdã, Holanda, v. 72, p. 56-69, jan. 2016.

CURT, M. D.; MAURI, P. V.; SANZ, M.; CANO RUIZ, J.; DEL MONTE, J. P.; AGUADO, P. L.; SÁNCHEZ, J. The ability of the *Arundo donax* crop to compete with weeds in central Spain over two growing cycles. **Industrial Crops & Products**, Amsterdã, Holanda, v. 108, p. 86-94, dez. 2017.

MEHMOOD, M. A.; IBRAHIM, M.; RASHID, U.; NAWAZ, M.; ALI, S.; HUSSAIN, A.; GULL, M. Biomass production for bioenergy using marginal lands. **Sustainable Production and Consumption**, Amsterdã, Holanda, v. 9, p. 3-21, jan. 2017.

MOURA PEREIRA, R.; CASAROLI, D.; QUIRINO, D. T.; MOURA CAETANO, J.; VELAME, L.M. Estimativa do índice de área foliar da cana-de-açúcar a partir de imagens do satélite Landsat-8 (OLI). **Anais XVII Simpósio Brasileiro de Sensoriamento Remoto - SBSR**, João Pessoa-PB, Brasil, 25 a 29 de abril de 2015, INPE.

RODRIGUEZ, L. D.; LAZARO, L.; RESSIA, J. M.; LADDAGA, J.; GROSSO, J.; BONGIORNO, C.; CONFALONE, A. Producción de biomasa de Arundo donax L., un cultivo bioenergético para el centro de la provincia de Buenos Aires. **Revista Argentina de Agrometeorologia (RADA)**, v. 12, p. 15 - 20. 2021.

TRIANA, F.; NASSI O DI NASSO, N.; RAGAGLINI, G.; RONCUCCI, N.; BONARI, E. Evapotranspiration, crop coefficient and water use efficiency of giant reed (*Arundo donax* L.) and miscanthus (*Miscanthus X giganteus* Greef et Deu.) in a Mediterranean environment. **Global Change Biology Bioenergy**, Illinois, EEUU, v. 7, p. 811-819, jan. 2014.

VOLTA, A.; VILLANI, G.; MARLETTO, V.; CEOTTO,E. Growth of the perennial energy crop giant reed (*Arundo* donax L.) simulated with ARMIDA, a modified version of the LINTUL model. **Italian Journal of Agrometeorology**, Florença, itália, v. 34, n. 3, p. 5-12, jan. 2016.

ANALYSIS OF CHLOROPHYL A FLUORESCENCE IN DIFFERENT VARIETIES OF SHISO

Julia Ramos de Oliveira [1], Daniel Moncada Pereira Marques [2], Nicole Pereira de Souza Rocha [2], Rebecca de Andrade Klein Ricardo [2], Gabriela Martins Corrêa [2], Natália Fernandes Rodrigues [3], Cristina Moll Hüther [2]

[1] Federal Fluminense University (UFF), Brazil (jroliveira@id.uff.br)
[1] Federal Fluminense University (UFF), Brazil
[3] Rio de Janeiro Federal Rural University (UFRR), Brazil

Abstract

Perilla frutensces L., the shiso, is an annual medicinal herb that has two most commonly cultivated varieties, green and purple, which differ through the chemical constituents of secondary products. The present work aimed to compare the photochemical activity of two varieties, green and purple, of *Perilla frutescens*, when cultivated in tropical regions of the country, through the analysis of chlorophyll fluorescence *a*, in order to contribute with information for the cultivation of this species in Brazilian territory. For the treatments, seedlings of the two varieties were planted in pots containing vegetal soil substrate and placed in a greenhouse with 70% shade. Chlorophyll fluorescence analysis was performed in the morning 35 days after transplanting. The chlorophyll fluorescence parameters showed a better photochemical activity for the green variety only when related to the reactions involved in photosystem I, with energy loss along the electron transport chain. The green variety showed better photochemical activity only when related to the reactions involved in photosystem I, with energy loss along the electron transport chain leaving photosystem II.

Keywords: perilla, photochemistry, primary metabolism, medicinal plant, nutritionally complete food

INTRODUCTION

Scientifically named *Perilla frutensces* L., shiso is an annual medicinal herb belonging to the Lamiaceae family native to Asia (Singh et al., 2022). This species has two most commonly cultivated varieties, green and purple, which are differentiated by the chemical constituents of secondary products (Meng et al., 2006). The coloration of the purple variety is due to a higher amount of anthocyanin, while in the green variety trace levels of anthocyanins have been detected (Yamazaki et al., 2003).

Studies about its compounds have been conducted to better understand its phytotherapeutic properties. The presence of biocomponents such as rosmarinic acid, linoleic acid, and flavonoids provides antimicrobial, antiallergic, anti-inflammatory, antiviral, and anti oxidant activity (Hashimoto et al., 2022; Singh et al., 2022).

Besides its therapeutic use, shiso is strongly used in oriental cuisine in several dishes. In Japan it is believed that shiso inhibits the toxic principles of crustaceans and other seafood, making it an essential ingredient in the preparation of these dishes (Peter, 2006). Shiso seeds are composed of protein, fiber, and oil, and are a great source of omega-3, making them a nutritionally complete food (Gaihre et al., 2022).

The various applications of *Perilla frutescens* L. confer a great economic potential to be exploited. Currently, in Brazil, its cultivation is restricted to the city of Mogi das Cruzes, in the state of São Paulo, which has Asian colonies (Oliveira and Masiero, 2005), so research on the ideal growing conditions in the Brazilian climate is incipient.

The present work aimed to compare the photochemical activity of two varieties, green and purple, of *Perilla frutescens*, when cultivated in tropical regions of the country, through the analysis of chlorophyll fluorescence *a*, in order to contribute with information for the cultivation of this species in Brazilian territory.

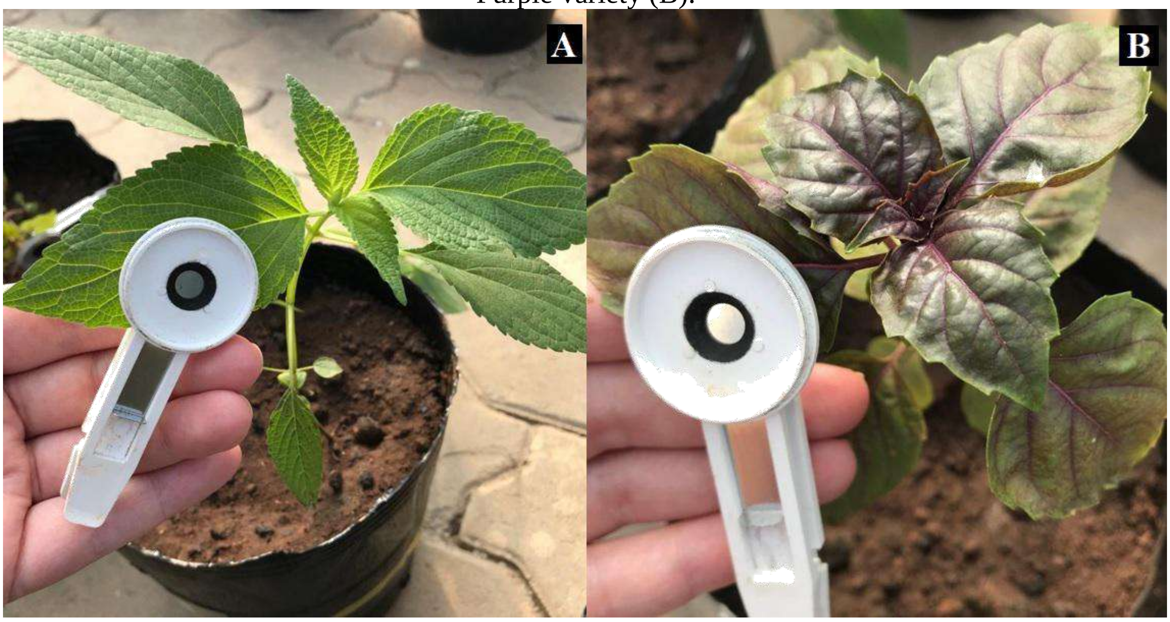
MATERIALS AND METHODS

The experiment was conducted in an experimental area belonging to the Fitoterápico Farmácia Viva program at Universidade Federal Fluminense, in a greenhouse, on the Gragoatá campus, Niterói (RJ), coordinates 22º 54' 00"S, 43º 08' 00"W and altitude of 8m. According to the Köppen classification, the region has an Aw climate, being a tropical climate with dry winter and rainy summer, with a mean annual temperature of 23ºC and mean annual precipitation of 1200 mm.

The shiso plants used were transplanted 35 days after sowing (35 DAS) into 4 liter pots containing Terra Vegetal substrate. Subsequently, the pots were randomly placed in a 70% shaded, plastic house, receiving an average of 100 ml of irrigation each until the end of the experiment. The experiment was conducted from November 2021 to January 2022, comprising the spring-summer season.

Chlorophyll *a* fluorescence analysis was performed in the morning 35 days after transplanting (35 DAT), where the leaves were previously dark adapted using a closed clip for a period of 30 minutes (Figure 1).

Figure 1: Dark adaptation by clip performed on leaves of Perilla frutensces L. Green variety (A); Purple variety (B).

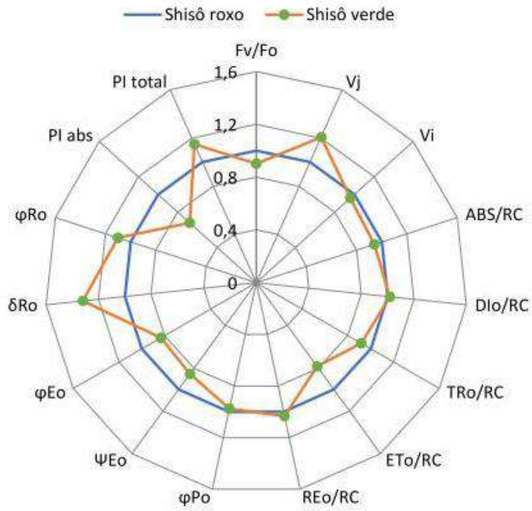


A portable fluorometer, model Handy PEA (Hansatech Instruments, King's Lynn, Norfolk, UK) was used for measurement and the parameters were calculated based on methodology proposed by Strasser & Strasser (1995) and Tsimilli-Michael & Strasser (2008).

RESULTS AND DISCUSSION

According to the results obtained from the chlorophyll a fluorescence analysis, it was possible to observe the variation in the electron transport chain according to the variety of shiso (Figure 2), with the purple variety used for normalization as a control, given that it is the most used for commercialization.

Figure 2: Chlorophyll a transient fluorescence parameters of shiso (Perilla frutescens L.) plants 35 days after transplanting.



The ratio of variable fluorescence to minimum fluorescence (Fv/Fo) of the green variation expressed lower index when compared to the control, indicating low effective photochemical energy conversion yield and inefficiency of photosystem, reducing the efficiency of the photosynthetic process.

As for the OJIP parameters, the relative variable fluorescence in step J (Vj) showed a higher index than the control, which shows greater efficiency of the intersystem, that is, in the transport of electrons between photosystems II and I. The relative variable fluorescence in step I (Vi) remained at the control level.

Regarding the yields and flux ratios, the primary photochemical maximum quantum yield (φPo) of green shiso remained at the control level. The probability that a captured éxciton in moving an electron in the electron transport chain after QA (ψEo) for the green variety remained below normalized, as well as the quantum yield of electron transport from QA to the electron acceptor intersystem (φEo), which also demonstrates the lack of efficiency of photosystem II.

The quantum yield of reduction of the final electron acceptors of photosystem I per absorbed photon (φRo) and the efficiency with which an electron can move from the reduced intersystem electron acceptors to the final electron acceptors of photosystem I (δRo) of green shiso showed higher than the normalized index, proving the effectiveness of electron transport between the two photosystems.

Regarding the parameters of specific fluxes or activities expressed per reaction center, the absorption flux per reaction center (ABS/RC), the captured energy flux per reaction center (TR0/RC), and the electron transport flux per reaction center (ET0/RC) remained at a level below the control. The energy dissipation per reaction center (DI0/RC), on the other hand, remained at a normalized level.

The specific electron flux with the capacity to reduce the final electron acceptors in the electron acceptor portion of photosystem I per active reaction center (RE0/RC), remained at the control level. Despite the low energy uptake and low electron transport, there is an absence of dissipation, and thus the normalization of RE0/RC infers reduction efficiency and the production of NADPH. NADPH production is of extreme importance in the photosynthetic process because they are energy intermediate cofactors agents of carbon dioxide fixation into carbon hydrates.

In respect to the performance indices, the total performance index (PIabs), related to the energy conservation of the photons absorbed by photosystem II until the reduction of the electron acceptors intersystem was lower in the green variation, indicating, again, the inefficiency of photosystem II. The total performance index, measuring the performance up to the final electron acceptors of photosystem I (PItotal) expressed higher index than the control, showing good performance, mainly contributing to this fact the better activity related to the parameters involved with photosystem I.

CONSIDERATIONS

When grown in tropical climates, the two varieties of shiso respond differently to photochemical activity. The chlorophyll fluorescence parameters showed a better photochemical activity for the green variety only when related to the reactions involved in photosystem I, when compared to the photosystem II parameters. The electron transport was affected in the green variety, but did not have a greater dissipation of energy, which shows that the energy loss was not related to the process of heat loss but rather along the electron transport chain leaving photosystem II. These changes do not effectively disrupt the electron transport chain, and such species can be grown under the tropical growing conditions of this work.

PRESENTATION: https://youtu.be/DM7ZZrLHMYw

REFERENCES

GAIHRE, Y. R.; IWAMOTO, A.; OOGAI, S.; HAMAJIMA, H.; TSUGE, K.; NAGATA, Y.; YANAGITA, T. 2022. Perilla pomace obtained from four different varieties have different levels and types of polyphenols and anti-allergic activity. **Cytotechnology**, 74:341-349.

HASHIMOTO, M.; MATSUZAKI, K.; MARUYAMA, K.; HOSSAIN, S.; SUMIYOSHI, E.; WAKATSUKI, H.; KATO, S.; OHNO, M.; TANABE, Y.; YAMAGUCHI, S.; KAJIMA, K.; OHIZUMI, Y.; SHIDO, O. 2022. Perilla seed oil in combination with nobiletin-rich ponkan powder enhances cognitive function in healthy elderly Japanese individuals: a possible supplement for brain health in the elderly. **Food Funct.**, 13:2768-2781.

MENG, L.; LOZANO, Y.; BOMBARDA, I.; GAYDOU, E.; LI, B. 2006. Anthocyanin and Flavonoid Production from Perilla frutescens: Pilot Plant green tea (Camellia sinensis). **Phytomedicine**, 10:517-522.

OLIVEIRA, H. A.; MASIERO, G. 2005. Estudos Asiáticos no Brasil: contexto e desafios. **Rev. Bras. Polít. Int.** 48(2):5-28.

PETER, K. V. **Handbook of herbs and spices**: volume 3. 2006. 566p

SINGH, S.; SINGH, S; KUMAR, S.; VERMA, S. K. 2022. Biological activities and therapeutic potential of perilla frutescens (purple mint): a review. **IJPSR**, 13(2):1000-09.

STRASSER, B. J.; STRASSER, R. J. 1995. Measuring fast fluorescence transients to address environmental questions: the JIP-test. In: Mathis, P. (Ed.). **Photosynthesis: from light to biosphere** editor. Dordrecht: Kluwer Academic Publishers, 5:977-980.

TSIMILLI-MICHAEL, M.; STRASSER, R. J. 2008. In vivo assessment of stress impact on plants' vitality: applications in detecting and evaluating the beneficial role of mycorrhization on host plants. In: Varma, A. (Ed.). **Mycorrhiza: state of the art, genetics and molecular biology, eco-function, biotechnology, ecophysiology, structure and systematic**s. 3:679-703.

YAMAZAKI, M.; NAKAJIMA, J.; SUGIYAMA, M. Y. M.; MAKITA, Y.; SPRINGOB, K.;

AWAZUHARA, M.; SAITO, K. 2003. Metabolomics and differential gene expression in anthocyanin chemo-varietal forms of Perilla frutescens. **Phytochemistry**, 62(6):987-995.

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APPLICATION OF RAPID DIAGNOSIS OF SOIL STRUCTURE (DRES) IN ARGILOUS RED-YELLOW LATOSOL IN THE REGION OF CACHOEIRAS MACACU-RJ

Flávio Lessa Machado [1], Guilherme Cangussú Donagemma [2], Róberson Machado Pimentel [3], Josiane da Silva Torres Machado [4]

[1] Federal Fluminense University (UFF), Brazil (flaviolessa@id.uff.br)
[2] Embrapa Solos, Brazil
[3] Federal Fluminense University (UFF), Brazil
[4] Federal University of Rio de Janeiro – UFRJ

Abstract

Degradation is a problem that affects about 50% of the country's pastures, an anthropic activity that most occupies soils in Brazil. There is a need to recover these areas for the maintenance of the Brazilian herd. Soil formation is influenced by its parent material, where chemical and mineral materials form the soil texture. The search for fast, economical and easily applicable methods has been the best alternative for field analysis, such as the Rapid Diagnosis of Soil Structure (DRES). Therefore, the objective of this work was to qualify the soil structure in 4 levels of degradation of pasture areas in the region of Cachoeiras de Macacu/RJ. Three soil samples were collected from each repetition (4) from each of the 4 levels in the 16 experimental areas. After the analysis, it can be observed that, although the pasture visually shows differences, such as the presence of invasive plants, small areas of exposed soil and the appearance, in the analysis of the soil structure statistically there were no significant differences between levels 1, 2 and 3. The difference was more evident at level 4, where the soil showed more evident signs of degradation, especially in the considerable presence of exposed soil. The DRES allowed the characterization of the soil structure quality quickly and simply.

Keywords: Rapid diagnosis, Management, Physical quality.

INTRODUCTION

The identification and classification of pasture degradation level is the starting point to understand the processes and causes that triggered the quantitative and/or qualitative pasture losses, as well as guide pasture recovery or reform.

To carry out the analysis of a soil there are several laboratory and field methods. Laboratory analyzes demand costs and time due to the distance from the collection site and the laboratories. The search for quick and low-cost analyzes in addition to easy application has become a better alternative, such as the use of the Rapid Soil Structure Diagnosis (DRES), developed by the Empresa Brasileira de Pesquisa Agropecuária.

This method consists of evaluating the surface layers of the soil in the first 25 cm, where the size of clods and aggregates is evaluated, in addition to biological activity and root depth, among others (RALISCH et al., 2017). Given the above, the objective of the work was to qualify the soil structure in

4 levels of degradation of pasture areas in the region of Cachoeiras de Macacu/RJ.

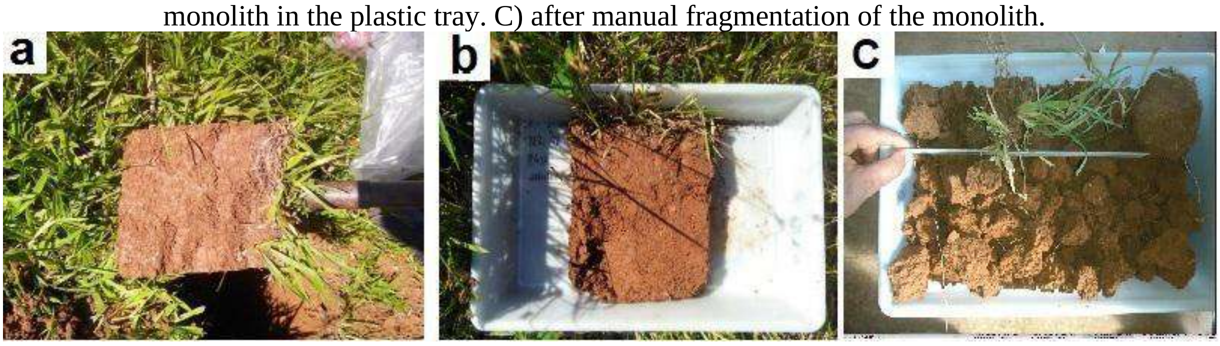
MATERIALS AND METHODS

The study was carried out at the Fazenda Escola da UFF and on nearby rural properties. The predominant soil class in the study area is the clayey Red-Yellow Latosol (CARVALHO FILHO et al., 2001). The climate of the region, Köppen (1938), type Af, tropical, with annual precipitation of 2,419 mm, 21.9 ºC is the average annual temperature. The study area is characterized by dissected hills and low hills (between 10% and 20% slope).

The treatments were: Level 1 – light degradation, with a predominance of the forage of interest; Level 2 – moderate degradation, such as some occurrence of invasive plants; Level 3 – strong degradation, with the presence of invasive plants and the occurrence of exposed soil; Level 4 – very strong degradation, with predominance of exposed soil, erosion and invasive plants (SPAIN & GUALDRÓN, 1988; DIAS-FILHO, 2011). Following the method's guidelines, three blocks of each repetition of each level were collected in the 16 experimental areas.

The blocks (figure 1a) were accommodated in trays (figure 1b) to perform the manual fragmentation of the block in order to be expanded to the sides (figure 1c).

Figure 1: Monolith collection operation. a)Removal of the monolith; b) Accommodation of the monolith in the plastic tray. C) after manual fragmentation of the monolith.



The scores are used to calculate the sample soil structural quality index (IQEA) and the soil structural quality index (IQES). The IQEA is calculated using a weighted average, considering the layer grade (Qec) and its thickness (Equation 1). IQES, on the other hand, is calculated by the arithmetic mean of the scores of soil samples in the area (Equation 2).

$$IQEA = [(Ec1 * Qec1) + (Ec2 * Qec2) + (Ec3*Qec3)] / Etotal \qquad \text{(Equation 1)}$$

Where:

IQEA: sample soil structural quality index;
Ec: layer thickness in centimeters;
Qec: structural quality grade of each layer;
Etotal: total thickness or depth of the sample.

$$IQES = (IQEA1 + IQEA2 + ... + IQEAn) / n \qquad \text{(Equation 2).}$$

Where:

IQES: structural soil quality index on the assessed land
n: total number of samples.

After collection, conservation, degradation, compaction, aggregates, roughness, biological activity, root distribution, among others, were evaluated. One of the criteria evaluates the size of the aggregates, the shape, the roughness, where clods measuring between 1 and 4 cm tend to favor biological activity. Large or very small aggregates and fragments indicate signs of compaction and spraying respectively, and do not contribute to a good grade (RALISCH et al., 2017).

RESULTS AND DISCUSSION

After calculating the soil structure quality indices (IQES) of the degradation levels, it was possible to perceive the difference in grades. Level 4 presented a score (4.22) lower than the other levels (N1, N2 and N3), which obtained scores of 5.24, 5.08 and 5.14 respectively (graph 1). The DRES grade scale varies between 1 and 6.

Graph 1: DRES result of the four levels.

N1: Light degradation level; N2: Moderate degradation level; N3: Strong degradation level; N4: Very strong degradation level;
Different capital letters indicate statistical difference between degradation levels

Soil samples from level 1 showed signs of conservation, showed a greater amount of organic matter, greater occurrence of roots, lumpy characteristics and signs of less compaction. Samples N2 and N3 obtained scores similar to those of N1, but despite the small difference in the score, signs of compaction were more evident than in N1, in addition to larger aggregates after handling and greater presence of invasive plants.

Also in N1 there was a greater presence of earthworms, showing active biological activity, and longer roots. Thus, the N1, N2 and N3 soils were more structured and the N4 less structured. N4 showed greater evidence of compaction, with a class of aggregates measuring between 5 and 7 cm, little presence of roots, and significant presence of exposed soil and invasive plants.

CONSIDERATIONS

The DRES field evaluation method allowed, in a fast, simple and low cost way, the structural characterization of the soil. In this way, it is possible to indicate some type of management that can be started, preliminarily, for the process of recovering the quality of this soil. The application of this method helps in the analysis of the structural quality of the soil, but it does not exclude the need for the contribution of other more detailed methods that complement it. The method proves to be efficient and essential for decision-making in management.

PRESENTATION: https://youtu.be/XhNrxbvo8Wk

REFERENCES

CARVALHO FILHO, A.; LUMBRERAS, J. F.; SANTOS, R. D. The soils of the state of Rio de Janeiro. In: SILVA, L.C.; SILVA, H.C. (Org.). **Agro-environmental study of the State of Rio de Janeiro**. 1d.Brasilia: CPRM, 2001, v. 1, p. 1-35. Available at:

DIAS-FILHO, M. B. **Pasture degradation: what it is and how to avoid it**. Brasília, DF: Embrapa, 2017.

RALISCH, R.; DEBIASI, H.; FRANCHINI, J.C.; TOMAZI, M.; HERNANI, L.C.; MELO, A.S.; SANTI, THE.; MARTINS, A.L.S.; BONA, F. D. **Rapid Soil Structure Diagnosis** – DRES. 1. ed. London: Embrapa Soja, 2017, 64 f.

SPAIN, J.M.; GUALDRÓN, R. Degradation and Rehabilitation of Pastures. In: LASCANO, C.E.; SPAIN, J.M. (Ed.). **Establishment and Renovation of Pastures**. Cali: CIAT, 1988. p. 269-283.

ETHNOPEDOLOGY AND LOCAL POPULAR KNOWLEDGE OF FARMERS ABOUT LAND USE POTENTIAL IN AGROECOSYSTEMS IN THE SEMI-ARID PIAUIENSE

Raimundo Nonato de Sousa [1], Prof. Dr. Isaias Pereira da Silva [2], Prof. Dr. Carlos Rodrigues Pereira [3]

[1] Graduate Program in Biosystems Engineering - PGEB at Federal Fluminense University (UFF), Brazil (raimundons@idu.uff.br)
[2] Federal Institute of Science and Technology of Pará
[2] Graduate Program in Biosystems Engineering - PGEB ate Federal Fluminense University (UFF), Brazil

Abstract

Soil management practices can be understood, in a specific region, as the result of a long period of application and adjustment of techniques employed by the population of farmers in that region. Understanding the mechanisms involved in these practices and the popular perception about them is of fundamental importance for the study of ethnopedology and popular knowledge. This work aimed to promote dialogue, identify, rescue and value the local knowledge of farmers about the potential for land uses in agroecosystems in the semi-arid region of Piauí. Two visits were made to the settlement of rural producers Nova Esperança, in which conversation circles were held for data acquisition. The productive areas, the differentiated vegetation cover in different faces of the landscape (cardinal orientation), the differentiation of soil fertility between the highest and lowest areas of the landscape were identified, the indicators of this fertility being the Mofumbo (*Combretum leprosum* Mart 1841), Faveira (*Parkia pendula* (Willd.) Benth., 1846) and Parreira brava (*Chondrodendron tomentosum* (Ruiz & Pavon), 1798). The indications collected in the conversation circles, about land use, proved to be consistent with what is expected in a landscape of undulating topography.

Keywords: dialogues. Popular knowledge. Family farming.

INTRODUCTION

Ancestral populations carry secular knowledge about land use and the knowledge built on the coexistence and management of the environment in which they live, has been disregarded by the specialized technical area (MATOS et al., 2014). Interaction and recognition by the academic environment are necessary to assess social agents' role as responsible and knowledgeable of the local specificities of agroecosystems (BARRERA-BASSOLS et al., 2006).

Ethnopedology promotes dialogue and the exchange of knowledge, facilitates the understanding of the problems that traditional populations face, in addition to contributing to the construction of collective knowledge, for the elaboration of a plan for the use of agroecosystems, respecting the reality and the need of local populations (MATOS, 2008). Local knowledge is associated with the way of dealing with ways of life and organization, centered on its territory, on the feeling of belonging in the form of land use and with its crops for its survival, the observation of the results is fundamental to improve and determine soil quality, according to Audeh et al. (2011).

Traditional populations carry a great deal of understanding and information, which were built on their relationships with ecosystems. This cultural wealth and its structures of social organization, which values and uses its knowledge, its practices that are elaborated and built in the experience, as they are transmitted by the tradition of their territories and natural resources conserved, as a way of conserving their cultural life, social, religious, ancestral and economic (ALVES et al., 2011).

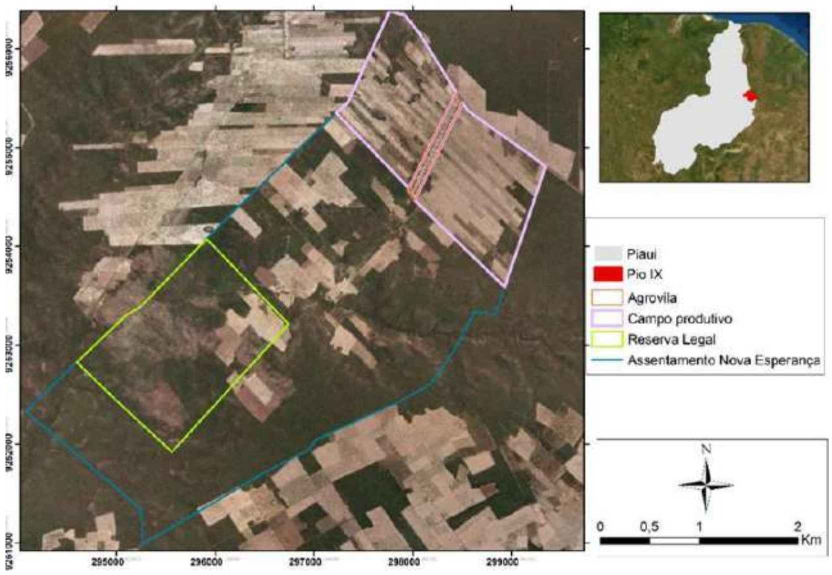
The use of scientific knowledge integrated with the knowledge of the local community expands the possibilities of achieving success in land use and occupation activities, increasing the sustainability and preservation of natural resources (AUDEH et al., 2011). Understanding the mechanisms involved in these practices and the popular perception about them is of fundamental importance for the study of ethnopedology and popular knowledge. This work aimed to promote dialogue, identify, rescue and value the local knowledge of farmers about the potential for land uses in agroecosystems in the semi-arid region of Piauí.

MATERIALS AND METHODS

The field study was carried out with the participation of ten leaders of the Association of Small Producers of the Nova Esperança Settlement. Located in the municipality of Pio IX, latitude 06° 50 '15” South, longitude 40° 34' 45" West, altitude 667 meters, in the semi-arid region of the State of Piauí in the Northeast region of Brazil (Figure 1).

Location and characterization of study areas

Figure 01: Location and characterization of the study areas



The conversation circle methodology was applied in order to apprehend the perception of soil quality indicators and the criteria for choosing the best areas for agricultural uses and animal husbandry. This technique is based on the generation and collection of information from the knowledge passed on from generation to generation integrated into the space in which they live. These results are part of the dissertation work, still under construction.

RESULTS AND DISCUSSION

During the conversation, it was possible to observe that farmers, when expressing their knowledge, acquired and maintained from generation to generation, allowed the residents of the settlement in question to develop social relationships based on orality, used in religious and cultural celebrations, to express about the soil quality, when referring to “good land” which means fertile soil. The use of this soil has guaranteed the survival and sustainable use of land and natural resources in that region. During the conversation circles, they pointed out that the lowlands were on good land, as the plants developed more, generating higher productivity.

In the pastures for animal husbandry, the lower areas allowed better animal production, since these areas received material from the higher part of the landscape, contributing to the fertility of the soil. Another observation is that they use natural vegetation as an indicator of soil quality. Among the indicator plants they considered Mofumbo (Combretum leprosum), Faveira (Parkia spp.), and Parreira brava (Chondrodendon platiphyllum).

The community clearly classified the land, its potential, location in the landscape, established quality indicators considering the soils and their faces (sides of some elevation) as environmental components. This understanding is in line with what Gonçalves (2000) says, in the North of Minas Gerais, that socio-environmental diversity creates cultural identity, allowing populations to classify and differentiate the environment according to the locations in which they live. This participatory discussion needs to be extended with the inclusion of laboratory analytical results as an instrument of knowledge and deepening of the relationship between scientific and local knowledge about land use acquired over hundreds of years from the daily experiences of the local community and the its relationship with the environment.

It was observed more frequently among farmers, the use of the term "land" to describe the quality of the soils. Due to the frequency of information in the conversation circles and the reports during the dialogue, it was noticed that this terminology is used by farmers for several generations and currently continues to be shared among local farmers.

In this context, it is possible to affirm that there is a range of knowledge on the part of farmers about the soil, acquired through practices and models of life in nature. This knowledge constitutes indicators of the quality of human life. Thus, ethnopedology must be an instrument of dialogue and exchange of knowledge between pedologists and farmers, which take into account the ways of life of traditional communities, the appreciation of their knowledge and the appreciation of their culture.

CONSIDERATIONS

The farmers involved in the work demonstrated mastery of the local knowledge discussed and were willing to share and exchange information.

The indications collected in the conversation circles, about land use, proved to be consistent with what is expected in a landscape of undulating topography.

PRESENTATION: https://youtu.be/7-iX8pzA2mg

REFERENCES

ALVES, H. S.; AZEVEDO, R. A. B.; Caracterização do manejo utilizado na classificação de solos por agricultores da região da Morraria – Cáceres/MT. **Revista de Biologia e Ciências da Terra**. V. 11 n 2. 2011.

AUDEH, S. J. S.; LIMA, A. C. R.; CARDOSO, I. M.; CASALINHO, H. D.; JUCKSCH, I. J.; Qualidade do solo: uma visão etnopedológica em propriedades agrícolas familiares produtoras de fumo orgânico. **Rev. Bras. de Agroecologia**. p.34- 48. 2011.

BARRERA-BASSOLS, N.; ZINCK, J. A.; RANST, E. V. Symbolism, knowledge and management of soil and land resources in indigenous communities: ethnopedology at global, regional and local scales. **Catena**, v. 65, p. 118-137, 2006. DOI: http://dx.doi. org/10.1016

GONÇALVES, C. W. P. As Minas e os Gerais - Breve ensaio sobre desenvolvimento e sustentabilidade a partir da Geografia do Norte de Minas. In: GUIMARÃES, P. W. et al. **Cerrado e desenvolvimento: tradição e atualidade**. Montes Claros: Unimontes. 2000, p. 19-45.

MATOS, L. V. **Conhecimentos na análise de ambiente: a pedologia e o saber local em comunidade quilombola do norte de Minas Gerias**. Dissertação (Mestrado) Universidade Federal de Viçosa. Viçosa MG. 2008.

MATOS, L. V. et al. O conhecimento local e a etnopedologia no estudo dos agroecossistemas da comunidade quilombola de Brejo dos Crioulos. **Sociedade & Natureza**, v. 26, p. 497-510, 2014.

EVALUATION OF THE INFLUENCE OF SOILS WITH DIFFERENT LEVELS OF NATURAL FERTILITY ON THE GROWTH OF BEAN (PHASEOLUS VULGARIS) AND CREOLE MAIZE (ZEA MAYS) CROPS.

Jéssica Raposa Rocha [1], Jóice Azeredo Silva [2], Caio Ferreira Dias [2], Pedro Almeida Soares [2], Vilmar Lopes Pinho [2], Daniela Marques Correia [2], Carlos Rodrigues Pereira [2]

[1] Federal Fluminense University - UFF, Brazil (jessicaraposa@id.uff.br)
[2] Federal Fluminense University - UFF, Brazil

Abstract

Most tropical soils have low pH and low natural fertility, which hinders the growth of the main crops of commercial interest, such as corn and beans. In this regard, the present work aimed to evaluate the response of two different levels of natural fertility on the growth of common beans (*Phaseolus vulgaris*) and creole corn (*Zea mays*). For that, a consortium of both species was planted in two different soils. The soils were physically and chemically characterized by means of four replicates of deformed samples collected at depths between 0 and 30 cm. Subsequently, the evolution of plant growth was monitored through height measurements up to 93 days after planting (DAP). Bean and corn plants obtained the highest heights in soil fertility conditions A. The exchangeable aluminum level in soil B points to a possible plant toxicity, which, together with other nutritional deficiencies, resulted in low crop growth and increased vulnerability to pest attacks. Consequently, all plants forming the agriculture consortium of soil B died, causing the interruption of data collection from 51 DAP.

Keywords: Natural environment; Crop management; Degraded area.

INTRODUCTION

Brazilian soils are, for the most part, characterized as acidic and poor in nutrients, which hinders the growth of the main crops in the country. (BERNARDI *et al*., 2002).

In order to solve this limitation, conventional agriculture, from the 1950s onward, was based on modern practices of mineral and organic fertilization to supply the lack of natural soil fertility associated with high acidity and the presence of toxic aluminum levels (BERNARDI *et al*., 2002). The objective was to reach optimal productivity levels for the plantations, especially those aimed at grain production. (COELHO and FRANÇA, 1995).

Currently, the concept of soil fertility has been studied holistically, as it highlights the indispensability of understanding how the soil-plant system interacts, replacing the practice of only supplying the lack of main nutrients (nitrogen, phosphorus and potassium). Primavesi (2021) emphasizes the need for a balance between macro and micronutrients, given the importance of the latter, often neglected, in the activation of enzymes in plant metabolism processes.

When working with the soil-plant system, Bernardi *et al.* (2002) state that each plant influences the root environment differently. Therefore, the authors reinforce the need to carry out studies on those interactions, in particular, the interactions between nutrients found in the soil and their effect on the growth of agricultural species.

Considering the aforementioned discussions, this work aimed to evaluate how the natural fertility of two different soils impacts the growth of bean (*Phaseolus vulgaris*) and creole corn (*Zea mays*) species.

MATERIALS AND METHODS

The experiment was conducted in the city of Niterói, RJ, at a location called Muriqui de Cima, situated at the geographic coordinates of 22º 54’ 59” S, 43º 02’ 27” W and altitude of 206 meters.

The experimental area was divided into two blocks of 500 m², where seeds were planted, in consortium, of black beans (*Phaseolus vulgaris*), okra (*Abelmoschus esculentus*), creole corn (*Zea mays*) and pigeon pea (*Cajanus cajan*).

The soils of the two experimental blocks (Soil A and Soil B) were characterized by collecting samples with four replications in each block at a depth of 0 – 30 cm (Table 1).

Table 1: Physical and chemical characterization of soils A and B evaluated in the experiment.

Parameter	Unit	Soil			
		A	Class*	B	Class*
Sand	g/kg	604,17	-	405,58	-
Silt	g/kg	164,08	-	148,92	-
Clay	g/kg	231,75	-	445,50	-
pH	-	4,33	Low	4,07	Low
Ca^{2+}	$mmol_c/dm^3$	9,75	Low	3,08	Low
Mg^{2+}	$mmol_c/dm^3$	7,00	Medium	3,92	Low
K^+	$mmol_c/dm^3$	1,96	Medium	0,39	Very low
Zn	mg/dm^3	1,27	Medium	0,29	Low
Fe	mg/dm^3	152,83	High	32,33	Medium
S	mg/dm^3	6,00	Medium	46,58	High
Mn	mg/dm^3	53,71	High	0,75	Low
Al^{3+}	$mmol_c/dm^3$	4,83	Medium	15,58	High
$H + Al^{3+}$	$mmol_c/dm^3$	33,75	Medium	60,67	High
SB	%	19,33	Low	7,99	Low
CEC	$mmol_c/dm^3$	53,08	Medium	68,66	Medium
V	%	34,67	Low	11,75	Low
OM	g/dm^3	14,00	Low	9,25	Low
P	mg/dm^3	5,75	Very low	3,40	Very low

Note: SB: sum of bases, CEC: cation exchange capacity, V: base saturation, OM: organic matter. *(PREZOTTI and MARTINS, 2013; SOBRAL *et al.*, 2015)

Source: IBRA, 2021.

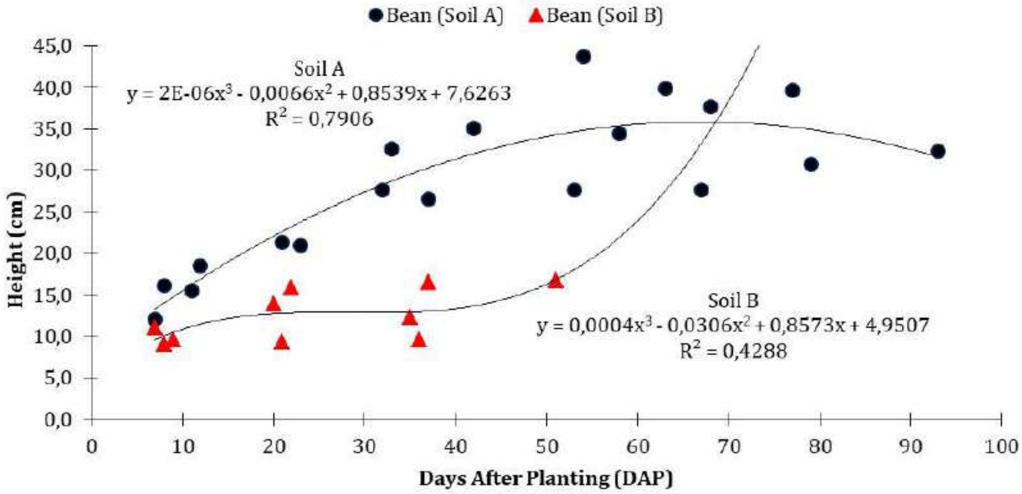
Visually, soil A had a dark color, some punctual trees, which provided a level of shading, and was occupied by brachiaria grass before the sowing. Soil B no longer had the A horizon and therefore presented a red-orange coloration, a certain level of densification and did not contain any cover or shading.

Plant height was obtained by measuring the aerial part, from the soil surface to the upper limit of the last leaf insertion. For the soil A, five random height measurements were performed for 19 sporadic days until the 93rd day after planting (DAP). In the case of soil B, five random height measurements were taken during 10 sporadic days until the 51st day after planting.

RESULTS AND DISCUSSION

From the graphic observation of the height measurements of the agricultural species under study, it was possible to perceive that soil A presented the plants with the best growth results, both for beans (Figure 1) and for corn (Figure 2). This finding can be explained by the chemical analysis of soil A, which showed the best condition of natural fertility (Table 1).

Figure 1: Evolution of bean crop growth (*P. vulgaris*) in Soil A and Soil B.



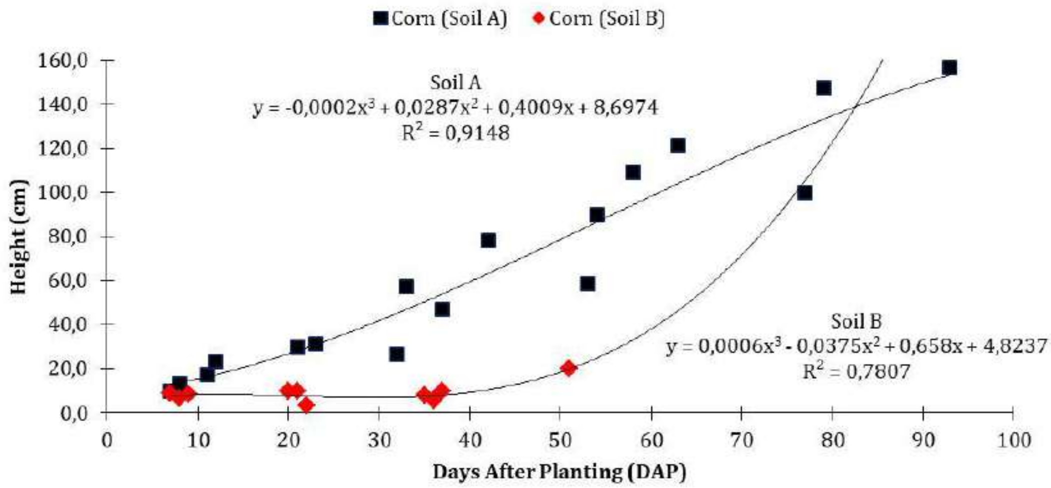
The maximum average height reached by the agricultural species *P. vulgaris* was 43.76 cm at 54 DAP and for *Z. mays* it was 156.37 cm at 93 DAP, the two results observed in soil A. In soil B, both *P. vulgaris* and *Z. mays* died and were no longer recorded from day 51 after planting. Thus, the maximum average height was 16.8 cm (*P. vulgaris*) and 19.8 cm (*Z. mays*) at 51 DAP. It is believed that the death was due to the plant`s intolerance to both low fertility and water stress in the dry spells during the growing season, since they showed severe signs of vulnerability.

The laboratory analysis showed that both soils had a low pH, a characteristic of great importance since acidity causes the neutralization of aluminum and manganese, which, in high concentration, are toxic elements to plants (BARROS and CALADO, 2014).

Rennenberg (1984) also highlights that low pH increases the availability of Al^{3+} to the roots, bringing negative effects such as thickening of the roots and inhibition of its growth, preventing the formation of root hair, reducing the absorption of nutrients and water, in addition to altering processes as the mineralization of organic matter (PREZOTTI and MARTINS, 2013; SOBRAL *et al*.,2015). Therefore, the high concentration of exchangeable aluminum, as observed in soil B (15.58 $mmol_c/dm^3$) is toxic, since it consists

of more than 40% of the effective CEC (PRIMAVESI, 2021), around 68%, and one of the probable reasons for the low growth registered for beans and corn.

Figure 2: Evolution of corn (*Z. mays*) crop growth in Soil A and Soil B.



Leal and Prado (2008), in a study with beans (*P. vulgaris* vr. Carioca), attested that the individual deficiency of nitrogen, phosphorus, potassium, calcium, sulfur, boron and zinc directly affect the vegetative growth of the crop, being the first three the main ones.

The low availability of phosphorus found in both soil A (5.75 mg/dm³) and soil B (3.40 mg/dm³) is also a limiting factor for crop growth when compared to plants in favorable fertility conditions. Bernardi *et al.* (2002) states that this is the nutrient that most limits productivity in most tropical soils, as it has a direct effect on the stimulation of root development and stem resistance, in addition to influencing flowering, fertilization, formation and maturation of grains (BARROS and CALADO, 2014).

Sulfur and potassium were the nutrients with the greatest difference between soil A (6.00 mg/dm³ and 1.96 $mmol_c/dm^3$, respectively) and soil B (46.58 mg/dm³ and 0.39 $mmol_c/dm^3$, respectively), with sulfur concentration being 87% higher in soil B and potassium 80% higher in soil A. Rennenberg (1984) explains that roots do not present restriction in the absorption of sulfur sulfate and, cations such as

Al^{3+} and Ca^{2+}, stimulate the uptake of this sulfate by the plant. Thus, once this compound is translocated along the stem, it has to be taken up by the leaf cells. The immediate damage caused by excess sulfur absorbed is prevented by a number of metabolic processes, but it can cause negative effects over time.

The reduced growth of beans and corn in soil B may also be related to the amount of available potassium found (0.39 $mmol_c/dm^3$) classified as very low according to Prezotti and Martins (2013). Potassium is one of the main macronutrients that influence the increase in photosynthetic rate, improving growth and increasing plant resistance to water stress (BARROS and CALADO, 2014). Leal and Prado (2008) attested to the importance of the presence of this macronutrient in increasing the height during bean development (*P. vulgaris* vr. Carioca) when they recorded an average height of 97.5 cm in the control treatment with adequate fertilization, while the omission of potassium caused a reduction of 59% of the average height of the plants.

In the case of corn, Coelho and França (1995) point out that nitrogen, potassium, calcium, magnesium and phosphorus are among the greatest requirements of this crop, which in soil B presented, except for nitrogen that was not evaluated, a very low and low concentration for potassium and the others, respectively, indicating how the lack of these nutrients influences the growth of this crop.

CONSIDERATIONS

Based on the results presented in this study, it is possible to conclude that soil A presented the best growth for both bean and corn crops.

In a comparison between collected growth data for soil A and B, soil B recorded an average of 36% lower heights for beans, with a minimum percentage difference of 8% (7 DAP) and a maximum of 56% (21 DAP), while for corn, the average difference in growth was 51%, with a minimum of 11% (7 DAP) and a maximum of 79% (37 DAP).

Based on the laboratory analysis, soil A presented the best fertility conditions for all nutritional parameters evaluated, except for sulfur, which in the amount recorded for soil B may have caused plant toxicity.

The exchangeable Al^{3+} results associated with low pH and nutrient deficiency are indicative of low fertility and high acidity of soil B, justifying the lower heights of bean and corn crops grown in this soil.

PRESENTATION: https://youtu.be/Y5rpZTFNLfc

REFERENCES

BARROS, J. F. C; CALADO, J. G. A. **Cultura do Milho**. Évora: Universidade de Évora, 2014.

BERNARDI, A. C. C.; MACHADO, P. L. O. A., SILVA, C. A. Fertilidade do solo e demanda por nutrientes no Brasil. In: MANZATTO, C. M.; FREITAS JÚNIOR, E.; PERES, J. R. R. **Uso agrícola dos solos brasileiros**. Rio de Janeiro: Embrapa Solos. 2002. p. 61-77.

COELHO, A. M.; FRANÇA, G. E. de. **Seja o doutor do seu milho: nutrição e adubação**. 2 ed. Piracicaba: Potafos, 1995. 9p.

IBRA. Instituto Brasileiro de Análises. **Ensaios Agronômicos: Análise físico-química do solo**. 2022.

LEAL, R. M.; PRADO, R. de M. Desordens nutricionais no feijoeiro por deficiência de macronutrientes, boro e zinco. **Revista Brasileira de Ciências Agrárias**, v. 3, n. 4, p. 301-306, 2008.

PREZOTTI, L. C.; GUARÇONI, A. M. **Guia de interpretações de análise de solo e foliar**. Vitória, ES: Incaper, 2013. 104p.

PRIMAVESI, A. **Manejo ecológico do solo: a agricultura em regiões tropicais**. Cotia, SP: Brasil Franchising, 2021.

RENNENBERG, H. The fate of excess sulfur in higher plants. **Annual Review of Plant Physiology**, San Diego, v.35, p.121-153, 1984.

SOBRAL, L. F.; BARRETO, M. C. de V.; SILVA, A. J. da; ANJOS, J. L. dos. **Guia prático para interpretação de resultados de análises de solos**. Aracaju: Embrapa Tabuleiros Costeiros, 2015. 15p.

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GEOTECHNOLOGIES APPLIED TO THE PEDOLOGICAL SURVEY OF SOILS IN THE CERRADOS REGION

Roberto de Paula Pinto [1], Fábio Ferreira Dias [2], Isaías da Silva Pereira [2]

[1] Federal Fluminense University - UFF, Brazil (roberto_paula@id.uff.br)
[2] Federal Fluminense University - UFF, Brazil

Abstract

The work was carried out at the Botanical Garden of Brasília, and its objective was to survey and classify soils using geotechnical techniques. Landsat images, digital elevation model, relief, vegetation, soil and geological maps produced by the Brazilian Institute of Geography and Statistics (IBGE) and by the National Institute for Space Research (INPE) were used, as well as morphological profile description information. Free and open source QGIS software was used for the elaboration of thematic maps. Among the elements studied, the vegetation and the original material were determinant for the categorization of the soils into two orders Latosols and Quartz Neosols, carried out in a shorter time than the conventional survey.

Keywords: soil, map, geoprocessing, Botanical Garden

INTRODUCTION

The Cerrado is a biome with a greater diversity than the Amazon and occupies an area of about 24% of the Brazilian territory (203 million hectares) according to Lewis et al, (2022). Soil surveys are essential for planning and sustainable land use. Traditionally they are carried out in the field, laboratory analyses and interpretation of data with the elaboration of maps in office (RANZANI, 1969).

This is a laborious process of high cost. An alternative is the digital survey and mapping, of fast execution and low economic cost when compared to the traditional model (MCBRATNEY et al., 2003). Geographic Information Systems (GIS) are GIS can be used for this purpose by bringing together a large amount of spatial representation data, structuring and integrating them properly, making them tools for use in pedological survey Grunwald (2009).

The information is captured using numerical models allowing the inference of spatial variations of different soil types, from observations and knowledge of soils and correlated variables such as relief, climate, lithology, vegetation following what was assumed by Jenny (1941).

According to Lacerda and Barbosa (2012) when one knows the pedomorphological relations and has a selection of topossequence and the source material to be studied, one can infer on the distribution and classification of soils in the landscape.

The objective of this work is to use geotechnologies as a tool for the pedological survey of soils in the cerrado region without having to resort to conventional methodologies for soil classification considering the elements of the landscape. The work had as objective the survey and classification of soils by the use of geotechnologies techniques.

MATERIALS AND METHODS

The work was conducted in the Botanical Garden of Brasilia, located in the city of São Sebastião in the Federal District in the Cerrados region in a cutout, considering part of the landscape with flat to gently undulating elevation. Information bases were collected (maps, satellite images, shapefiles, lithological information, ALOS Phased MDE among others); Selection of Landsat 5 bands 4-3-2 and CBERS 4A: Bands 8-7-6 images for vegetation characterization by means of an identification key.

The relief was described by digital elevation model displaying. Validation will be by comparison with the pedological survey model of the study area which was taken as reference to evaluate the soil classification by Cavedsn and Sommer (1990). The soil classification was based on the formation processes of the model proposed by Jenny (1941), Giannetti et al. (2001) and EMBRAPA (2018) pointed out that the Latosols occur preferentially in flat to gently to undulating relief (0 to 10% slope) and the Quartzarenitic Neosols occur in flat to undulating relief (0 to 15% slope).

In other words, there is a pattern of soil behavior that can be evaluated and thus the EAW and the information of slope, vegetation and parent material can help identify the most likely soil for an area, as described in the work of Jenny (1941) and observed in geotechnological surveys of Giannetti et al. (2001), Lacerda et al (2012) and Wang (2020) demonstrating the trend of the model in the use of geotechnologies for soil classification.

The control points with soil profiles were inserted and satellite images were used with compositions that showed the vegetation as a differentiating element between Latosols and Neosols in the landscape.

RESULTS AND DISCUSSION

Relief is a good indicator of the distribution and evolution of soils in the landscape. It is expected to find Latosols. This is the most evolved soil order in the landscape and is strongly associated with elevated flat to gently undulating relief.

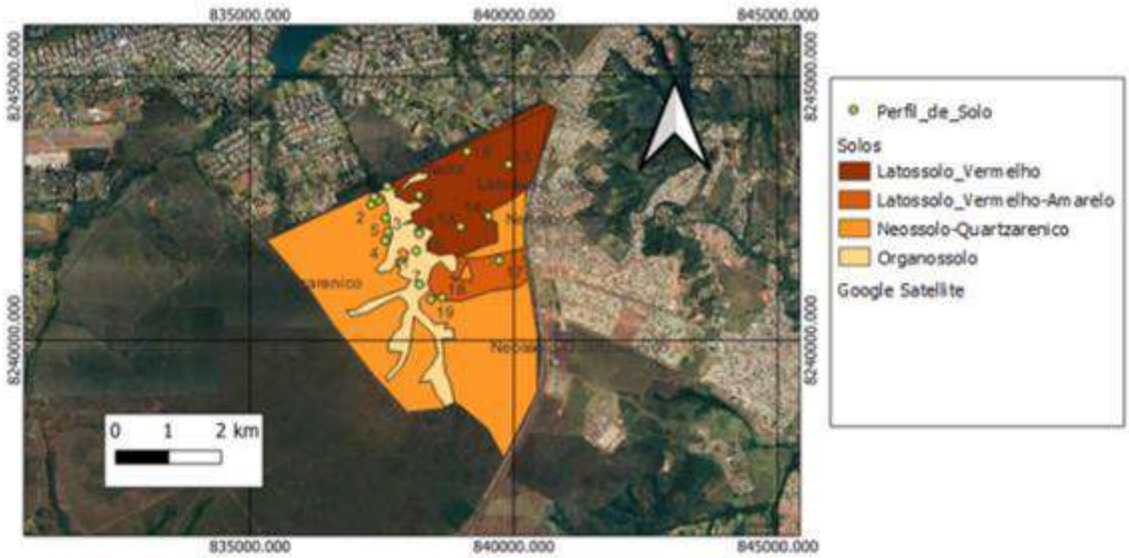
This was not fully confirmed and the presence of both Latosols and Quartz Neosols was observed. To differentiate it was necessary to consider the size of the vegetation that presented different structures and the material of origin. In the area of Latosols occur Cerrado Senso Stricto and Cerradão (Figure 1) of larger size on slate.

On the Neosols a campo sujo is observed characterized by grasses and small shrubs on quartzite (Figure 2). The weathering of the original material and the different size of the vegetation were determining factors for the classification of the soils using geotechnologies.

The greater development of vegetation on the Latosol can be attributed to the texture, organic matter stock, fertility and structure of the soil. This fact was not observed with the same intensity in the Quartz Neosol, poor in nutrients, sandy texture and highly susceptible to erosion.

Figure 1: Vegetation map of part of the polygonal area of the Botanical Garden. Source: Interaction of Landsat 5 Bands 4-3-2.

Figure 2: Soil classification system of part of the polygonal area of the Botanical Garden. Source: Interaction of Landsat 5 Bands 4-3-2.



CONSIDERATIONS

The results point to the potential of using this technology in the process of soil classification in less work and with greater precision;

In this condition, the relief was not determinant for the classification because it presented two orders of soils on a flat to gently undulating relief;

The different size of the vegetation and the different materials of origin were determinant for the classification of soils, by the use of geotechnologies, in two orders: Latosols and Quartz Neosols, performed in a shorter time than the conventional survey.

PRESENTATION: https://youtu.be/erZPCo-U3o8

REFERENCES

Brindis-Santos, A. I., Palma-López, D. J. Zavala-Cruz, J, Mata-Zayas, E. E., López-Bustamante, Y. I., Geomorphological landscapes related to the classification of soils in plains and terraces of Tabasco, Mexico, **Boletín de la Sociedad G. M.** 2020, 17p.

CARVALHO, C. C. N.; NUNES, F. C. E ANTUNES, M. A. H. Histórico do Levantamento de Solos no Brasil: da Industrialização Brasileira à Era da Informação, **Revista Brasileira de Cartografia, S.B.C**., Geodésia, Fotogrametria e S.R. (2013) Nº 65/5: 997-1013p. EarthDATA-ASF-Alaska_NASA

CASTRO, J. D. B. E NOGUEIRA, J. M. **Valoração Econômica do Meio Ambiente - Teorias e Práticas**. Curitiba: CRV, 2019, 188 p.

CAVEDON, A. D., SOMMER S., **Levantamento Semidetalhado dos Solos Escala 1:10.000**, Jardim Botânico de Brasília, S. Agri. DF e Fundação Zoobotânica, 1990, 95p.

EMBRAPA. Empresa Brasileira de Pesquisa Agropecuária. **Sistema brasileiro de classificação de solos**. 5. ed. Centro Nacional de Pesquisa de Solos, EMBRAPA Solos, Rio de Janeiro (2018), 306p.

GIANNETTI,F, MONTANAREILA, L., SALANDINL, R., Integrated use of satellite images, DEMs, soil and substrate data in studying mountainous lands, JAG l Volume 3 - Issue 1 – 2001, 5p.

GRUNWALD, S., Multi-criteria Characterization of Recent Digital Soil Mapping and Modeling Approaches. **Geoderma**, (2009) 195-207p.

IBGE - Instituto Brasileiro de Geografia e Estatística, **Manuais Técnicos em Geociências Divulga os Procedimentos Metodológicos Utilizados nos Estudos e Pesquisas de Geociências**. ISBN 85-240-3723-7 (CD-ROM) ISBN 978-85-240-3722-9 (meio impresso) © IBGE. 2ª edição (2007), 316 p.

INPE – Instituto Nacional de Pesquisas Espaciais. **Projeto TerraClass Cerrado Mapeamento do Uso e Cobertura Vegetal do Cerrado**. (2019).

INPE– Instituto Nacional de Pesquisas Espaciais, **Pesquisa e Desenvolvimento** (2018).

JENNY, H. **Factors of Soil Formation: a System of Quantitative Pedology**. Courier Corporation, (1941) 300p.

LACERDA M. P. C., BARBOSA, I. O., Relações Pedomorfogeológicas e Distribuição de Pedoformas na Estação Ecológica de Águas Emendadas. **R. Br. C. Solo**, 2012, 709 – 722p.

LEPSCH, I. F. **19 Lições de Pedologia**. São Paulo: Oficina de Textos, 2011. 456 p.

LEWIS, K..,Barros, F.V., Cure, M.B., Davies, C. A., Furtado, M.N., Hill, T.C.,Hirota, M., Martins D. L., Mazzochini G. G., Mitchard E. T. A., Munhoz C. B. R., Rafael S. Oliveira4, Sampaio A. B., Saraiva N. A., Schmidt, I. B., Rowland, L; .Mapping native and non-native vegetation in the Brazilian Cerrado using freely available satellite products. **Scientific Reports**, 2022, 17p.

MCBRATNEY, A. B., MENDONÇA, S.M. L., M. B., On Digital Soil Mapping. **Geoderma** 117, (2003) 52p.

NOVAIS, J. J., LACERDA, M. P. C., SANO, E. E., DEMATTÊ, J, A. M., OLIVEIRA JR M, P., Digital Soil Mapping Using Multispectral Modeling with Landsat Time Series Cloud Computing Based, **Remote Sens**, (2021), 18p.

RANZANI. G. **Manual de levantamento de solos**, 2 ed. Edgar Blücher, São Paulo, 1969, 316p.

SANTOS, H. G., JACOMINE, P. K. T., ANJOS, L. H. C., OLIVEIRA, V. A., LUMBRERAS, J. F., COELHO, M. R., ALMEIDA, J. A.; ARAUJO FILHO, J. C., OLIVEIRA, J. B., CUNHA, T. J. F., **Sistema Brasileiro de Classificação de Solos**. 5.ed., rev. e ampl. Brasília – DF: EMBRAPA, (2018). 356p.

GERMINATION AND GROWTH OF ACMELLA OLERACEA, ARTEMISIA ABSINTHIUM, BIDENS PILOSA, SALVIA OFFICINALIS AND PLANTAGO MAJOR

Jóice Azeredo Silva [1], Jéssica Raposa Rocha [2], Luccas Eduardo Ribeiro Martins Narciso [2], Elton de Oliveira [2], Daniela Marques Correia [2], Carlos Rodrigues Pereira [2], Naomi Kato Simas [3]

[1] Federal Fluminense University – UFF, Brazil (joiceazeredo@id.uff.br)
[2] Federal Fluminense University - UFF, Brazil
[3] Rio de Janeiro Federal University - Rio de Janeiro/ RJ, Brazil

Abstract

Medicinal plants are a relevant instruments of health care around the world, including in Brazil, being standardization of cultivation parameters important to promote the efficacy and safety of herbal medicines. Thus, this study had as objective to analyze five species of medicinal plants *Acmella oleracea* (L.) R.K.Jansen (jambu), *Artemisia absinthium* L. (wormwood), *Bidens pilosa* L. (blackjack), *Salvia officinalis* L. (sage) and *Plantago major* L. (plantain) in relation to the percentage of germination and initial growth, in a shaded greenhouse; and growth after transplanting, in a greenhouse without shading and in the open. The seeds of jambu, wormwood, blackjack, sage and plantain were sown in plastic trays in a shaded greenhouse. At 58 days after sowing, the seedlings were transplanted into pots and submitted to two environments, namely: a non-shaded greenhouse and in the open. The percentage of germination, the height of the seedlings in the tray and the height of the transplanted plants were evaluated. The percentage of germination found for blackjack was high with 80%, low for jambu with 40-50% and very low for plantain with 10% and 0% for wormwood. Regarding the growth, the blackjack and sage showed better responses than the other species. The growth of transplanted plants was positive in both environments, except for sage in the open, which showed stagnation. It is concluded that: the shading interfered negatively in the germination of wormwood and plantain; blackjack and sage had no interference from the shading; the transplantation presented good results in both environment, without shading.

Keywords: Medicinal plants; Controlled environment; Initial cultivation.

INTRODUCTION

The human, for his survival, has always sought nature to meet his needs (BRASIL, 2006). Thus, plants capable of mitigating or eliminating diseases, which can also be used as medicine, are known as medicinal plants (BRASIL, 2020). According to the World Health Organization (WHO), a medicinal plant is a plant that has, in one of its organs, substances with therapeutic purposes or precursors of semi-synthetic drugs (WHO, 1998 apud VEIGA JUNIOR and PINTO, 2005).

Medicinal plants are relevant health care instruments around the world, including in Brazil, and their use is encouraged by the WHO (BRAZIL, 2012). As a result, it has been necessary to define cultivation parameters for the therapeutic efficacy of these plants (ALEMAN and MARQUES, 2016).
Among some cultivation parameters, knowledge of germination conditions to maximize its production potential is important, the germination percentage is one of them (GUIMARÃES et *al*., 2010). In the

study with *Handroanthus serratifolius*, Santos et *al*. (2020) analyzed germination, seedling growth and growth after transplanting, using the analysis of germination percentage and seedling height.

Then, in this study seek to work with some species that are in the SUS, but there are not many studies of their cultivation parameters. Therefore, paper had the aim to analyze five species of medicinal plants *Acmella oleracea* (L.) R.K.Jansen (jambu), *Artemisia absinthium* L. (wormwood), *Bidens pilosa* L. (blackjack), *Salvia officinalis* L. (sage) and *Plantago major* L. (plantain) in relation to the percentage of germination and initial growth, in a shaded greenhouse; and growth after transplanting, in a greenhouse without shading and in the open.

MATERIALS AND METHODS

The experiment was carried out in the experimental area "Farmácia Viva", located on the Gragoatá Campus of the Universidade Federal Fluminense, in the city of Niterói-RJ, latitude of 22º 54´ 00´´ S, longitude of 43º 08´ 00´´ W and altitude of 8 m. Seeds of *Acmella oleracea* (L.) R.K.Jansen (jambu), *Artemisia absinthium* L. (wormwood), *Bidens pilosa* L. (blackjack), *Salvia officinalis* L. (sage) and

Plantago major L. (plantain) were sown, using 18 trays of 50 cells, filled with the commercial substrate Favorita® and kept in a greenhouse with shading, each tray being a repetition. Transplanting was carried out 58 days after sowing (DAS) to two different environments, a greenhouse without shading and in the open. The transplanted plants were only those that presented germination amount above 100 individuals and were planted in plastic pots containing openings at the bottom, gravel 0 and a layer of sand at the bottom for drainage, in addition to the substrate that was prepared with a 3:4:3 proportion ofred clay, dung and sand, respectively.

Were evaluated the germination percentage from 33 to 56 DAS, the seedling height from 29 to 58 DAS and the plant height, after transplanting in different environments, from 2 to 11 days after transplant (DAT). The germination percentage was calculated using the formula proposed in the Regras para Análise de Sementes (BRASIL, 2009). Height measurements were taken with a tape measure. The amount of seeds used and the repetitions per analysis are shown in Table 1.

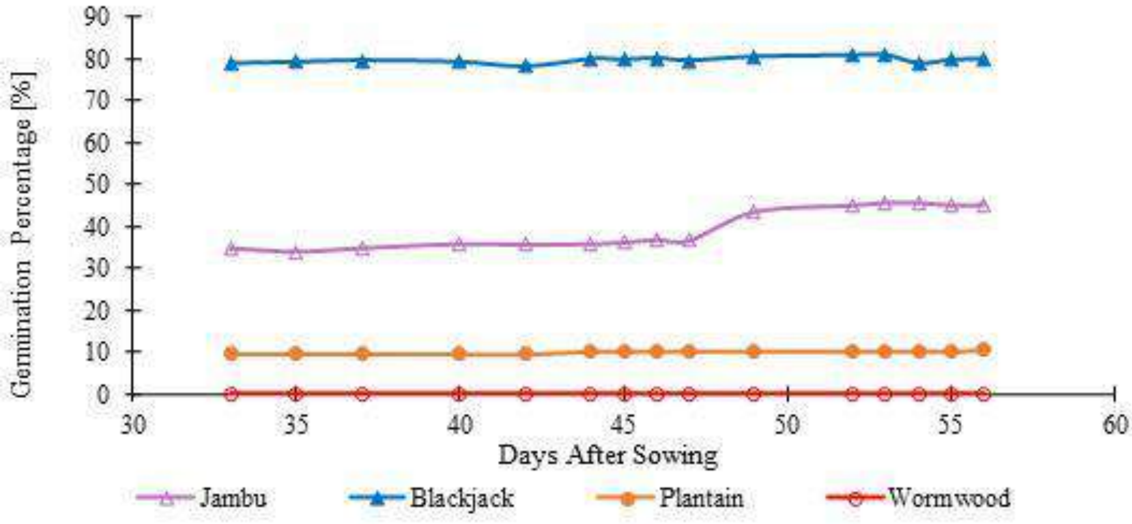
Table 1: Species Ratio, seeds by repetition and number of repetitions

Species	Seeds by repetition	Number of repetitions by analysis		
		Germination percentage	Plant height	Height after transplantation
Jambu *Acmella oleracea*	150	4	10	2
Wormwood *Artemisia absinthium*	50	3	10	-
Blackjack *Bidens pilosa*	150	4	10	5
Sage *Salvia officinalis*	100	3	10	3
Plantain *Plantago major*	100	4	10	-

RESULTS AND DISCUSSION

The germination percentage varied from one species to another, being the blackjack the one with higher germination percentage (Figure 1). In Figure 1, it is possible to see that one month after germination, only the jambu showed increase in germination.

Figure 1: Germination percentage of the medicinal plants jambu, wormwood, blackjack, sage, plantain.

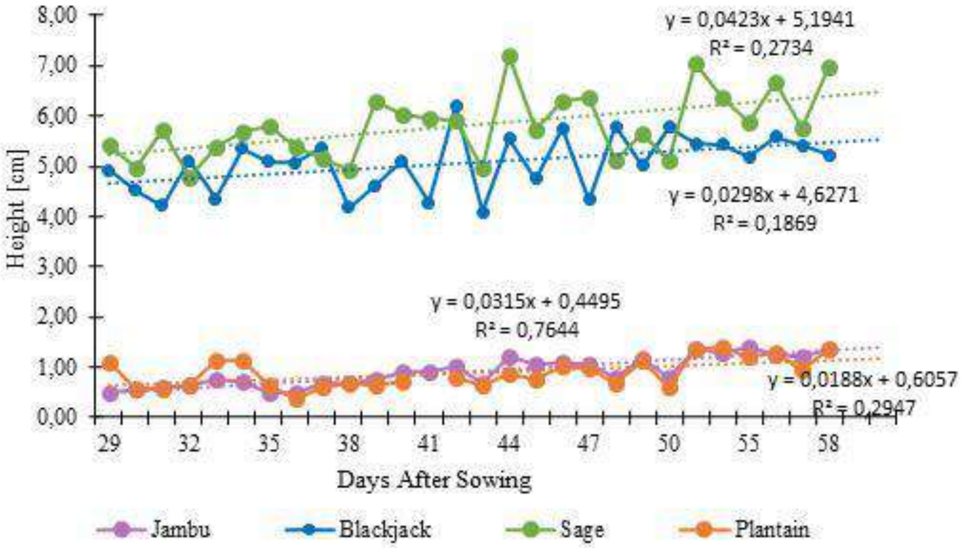


The germination of jambu presented a late growth, being its germination percentage greater than what was verified by Oliveira et *al*. (2012) in a dark environment, however below the results found in alternated environments or with constant illumination. As for the blackjack, the germination percentage was closer to what was verified by Adegas et *al*. (2003) of 87.5%. The wormwood, with 0% of germination and the plantain with 10%, showed a lower than expected percentage, according to the results found by Simão et *al*. (2010) and Cola et *al*. (2011), with 53% and 84% respectively.

This indicates that the wormwood and plantain did not present a good performance of germination in shaded environment, corroborating with Monteiro and Blanco (2018) in which the plantain in the absence of light presented low germination and in the presence of light showed improvement in this parameter. The sage presented inconsistent data, demonstrating a possible error in the sowing, being disregarded in the evaluation of the germination percentage.

The follow up of growth in the plants after germination is important for the transplantation, as indicated by Agehara and Leskovar (2014) that affirmed that the control of height of vegetables is relevant to a better adaptability in the transplantation. Thus, the Figure 2 shows the growth of medicinal plants seedlings in study, until the transplantation. Due to the lack of germination in the wormwood, the height variable of this plants was not analyzed.

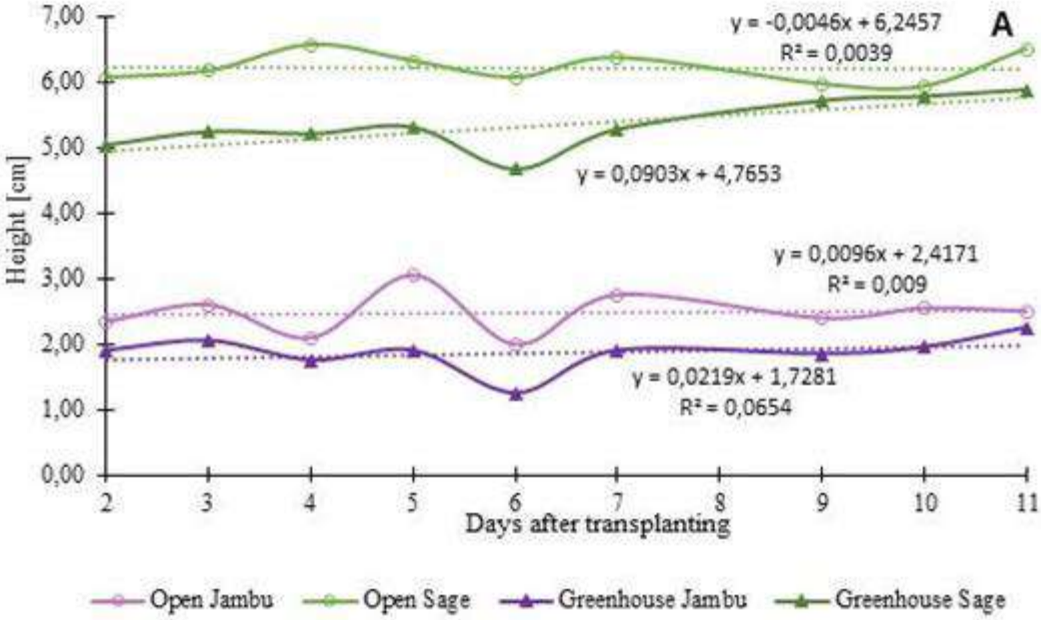
Figure 2: Evolution of height in plants of jambu, blackjack, sage and plantain

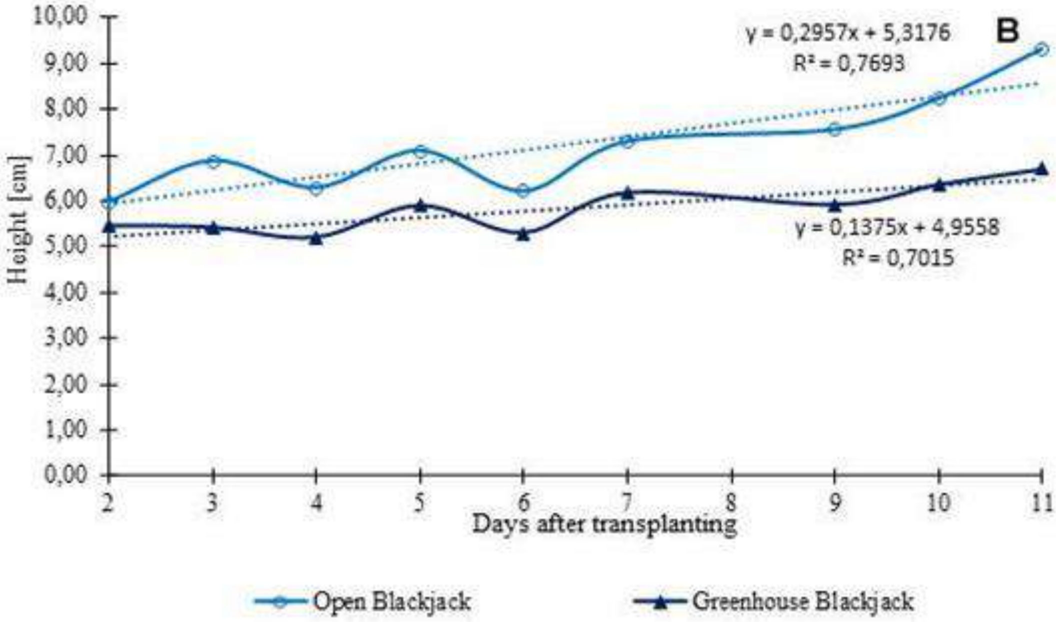


All the species presented a tendency of linear growth, however only the sage and blackjack presented greater heights. On the other hand, the jambu, despite the low heights, showed lower variations in growth indicated by small peak variations. Possibly, the difference in species growth is due to, the intensity of luminosity in the environment that, according to Taiz et *al*. (2017), can promote or inhibit the elongation of the hypocotyl in seedlings.

In the Figure 3 it can be observed the growth of the species, transplanted from two different environments. All the species cultivated in the open presented greater heights in relation the to plants that were growing in the greenhouse, even without shading.

Figure 3: Evolution of medicinal plants height after transplantation to pots in the open and to pots in the not shaded greenhouse. Sage and Jambu (A); Blackjack (B).





The transplantation showed good results considering the survival of all the transplanted plants and by the gain in height, as is indicated by the positive angular coefficient of the tendency line (Figure 3 A and B). However, the results of sage in the open points to an exception, indicating a possible stagnation of its growth. The heights of plants in the open environment were greater, but for the sage and jambu, the plants in the greenhouse presented higher growth evolution, given that the greater the angular coefficient the greater the increments in heights found (Figure 3 A). Besides that, the Figure 3 B showed that the blackjack, among all the transplanted species, was the one that presented greater growth in both environments.

CONSIDERATIONS

The shading interfered negatively in the germination of seeds of wormwood and plantain, not presenting greater discrepancies from the others when comparing to the literature. The initial growth in the germination of seedlings showed better results for the blackjack and sage.

The transplantation of jambu, blackjack and sage presented good results in both environments (in the open and in the greenhouse without shading), with a highlight for the blackjack growth.

New studies using these species are needed in order to comprehend the best physiological response of these plants to the place they are produced. Therefore, is possible to obtain an optimized environment for their production, for both germination and growth after transplanting.

PRESENTATION: https://youtu.be/3yVKN-ARLwI

REFERENCES

ADEGAS, F. S.; VOLL, E; PRETE, C.E.C. Embebição e germinação de sementes de picão-preto (*Bidens pilosa*). **Planta daninha**, v. 21, p. 21-25, 2003.

AGEHARA, S.; LESKOVAR, D. I. Age-dependent effectiveness of exogenous abscisic acid in height control of bell pepper and jalapeño transplants. **Scientia Horticulturae**, v. 175, p. 193-200, 2014.

ALEMAN, C. C.; MARQUES, P. A. Irrigation and organic fertilization on the production of essential oil and flavonoid in chamomile. **Revista Brasileira de Engenharia Agrícola e Ambiental**, v. 20, p. 1045-1050, 2016.

BRASIL. MINISTÉRIO DA SAÚDE. AGÊNCIA NACIONAL DE VIGILÂNCIA SANITÁRIA – ANVISA. **Medicamentos fitoterápicos e plantas medicinais**. Ministério da Saúde, 2020. Disponível em: . Acesso em 13 de out. de 2022.

BRASIL. MINISTÉRIO DA SAÚDE. SECRETARIA DE ATENÇÃO À SAÚDE. DEPARTAMENTO DE ATENÇÃO BÁSICA. **Práticas integrativas e complementares: plantas medicinais e fitoterapia na Atenção Básica**. Ministério da Saúde, 2012.

BRASIL. MINISTÉRIO DA SAÚDE. SECRETARIA DE CIÊNCIA, TECNOLOGIA E INSUMOS ESTRATÉGICOS. DEPARTAMENTO DE ASSISTÊNCIA FARMACÊUTICA. **A fitoterapia no SUS e o Programa de Pesquisa de Plantas Medicinais da Central de Medicamentos**. Ministério da Saúde, 2006.

BRASIL. **Regras para análise e sementes.** Ministério da Agricultura, Pecuária e Abastecimento. Secretaria de Defesa Agropecuária. Brasília: MAPA/ACS, 2009, p.395.

COLA, M. P. A.; COLA, G. P. A.; SILVA, N. C. B. GERMINAÇÃO IN VITRO DE SEMENTES DE PLANTAGO MAJOR. **XV Encontro Latino Americano de Iniciação Científica e XI Encontro Latino Americano de Pós-Graduação–Universidade do Vale do Paraíba**, 2011.

GUIMARÃES, M. D. A.; VIDIGAL, D. D. S.; LOUREIRO, M. E.; DIAS, D. C. F. D. S.; GUIMARÃES, A. R. Influência de temperatura, luz e giberelina na germinação de sementes de *Thlaspi caerulescens* J. Presl & C. Presl (Brassicaceae). Revista Ceres, v. 57, n. 3, p. 372-376, 2010.

MONTEIRO, T.S.F.; OLIVEIRA, E.T.; BLANCO, F.M.G. TESTES DE GERMINAÇÃO DAS SEMENTES DAS ESPÉCIES *Allium tuberosum* E *Plantago major*. **Biológico**, Suplemento, São Paulo, v.80, n.1,p.13- 78, jan./dez.,2018.

OLIVEIRA, O.; INNECCO, R. Germinação de sementes de jambu (*Acmella oleracea-Asteraceae*) sob influência de fotoperíodo e temperatura. **Revista Eletrônica de Biologia**, v. 5, n. 3, p. 105-118, 2012.

SANTOS, M. F.; SANTOS, L. E.; COSTA, D. L.; VIEIRA, T. A.; LUSTOSA, D. C. *Trichoderma* spp. on treatment of Handroanthus serratifolius seeds: Effect on seedling germination and development. **Heliyon,** v. 6, n. 6, p. e04044, 2020.

SIMÃO, M. J.; DAMASCENO, S.; NOGUEIRA, A. M.; GUIZARDI, P. S.; SILVA, N. C. B. Germinação in vitro de sementes de losna (*Artemisia absinthium* L.) em diferentes meios de cultura. **XIV Encontro Latino Americano de Iniciação Científica e X Encontro Latino Americano de Pós-Graduação–Universidade do Vale do Paraíba**, 2010.

TAIZ, L.; ZEIGER, E.; MØLLER, I. M.; MURPHY, A. **Fisiologia e desenvolvimento vegetal**. Artmed, Porto Alegre, 6. ed., 2017.

VEIGA JUNIOR, V. F.; PINTO, A. C.; MACIEL, M. A. M. Plantas medicinais: cura segura? **Química nova**, v. 28, p. 519-528, 2005.

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GERMINATION OF TWO SHISO VARIETIES ON COLORED MESHES

Nicole Pereira de Souza Rocha [1], Julia Ramos de Oliveira [2], Felipe Neves Verde [2], Rebecca de Andrade Klein Ricardo [2], Pedro Soares de Melo [2], Cristina Moll Hüther [2], Carlos Rodrigues Pereira [2]

[1] Federal Fluminense University – UFF, Brazil (nicolepsr@id.uff.br)
[2] Federal Fluminense University – UFF, Brazil

Abstract

Perilla frutescens L. is a native of the Asian continent, popularly known as perilla or shiso, and has two main varieties: purple and green. It has an important record in Chinese medicine and is used as a natural phytotherapic. The objective of this study was to verify how different types of colored photoselective meshes (black, red and blue) influence the germination process of two varieties of Perilla frutescens L, being purple and green. For the treatments, two varieties of P. frutescens (purple and green) were used in different greenhouse with 70% shading, with the following photoselective meshes (black, red and blue) arranged in three 200-cell trays, with 100 cells for each variety. MecPlant substrate was used. Germination started six days after sowing (DAS), stabilizing at 22 DAS, for all treatments. The seeds grown in the greenhouse with black mesh obtained the lowest percentage of germination, independently of the variety, and the highest percentage of germination was obtained in seeds grown in the greenhouse with blue mesh, for the green variety. In relation to the seeds grown in a greenhouse with red mesh, they showed an intermediate response to the other treatments. For the conditions of this experiment, it is advisable to cultivate this species in a greenhouse with colored meshes, especially blue, in order to favor the germination process.

Keywords: Perilla; Germination; Photoselectives; Shading.

INTRODUCTION

Perilla frutescens L., belongs to the family Lamiaceae, is found in Japan, China and Southeast Asia and two main varieties are common in Japanese cultivation, these being: Chirimen-aka shiso (Aka-Shiso), with red (purple) leaves, known as purple shiso and Chirimen-Ao-shiso (Ao-Shiso), with green leaves, known as green shiso (Omer et al, 1998). It is historically an important herb having its registration since around 500 AD in the classics of Chinese medicine and is a fast growing annual medicinal herb (Ahmed, 2018; Omer et al, 1998).

Shiso is propagated through seeds and its varieties are cultivated by direct seeding or raised in nurseries for transplanting (Pandey & Bhatt, 2008). There is much information in the literature about its uses as a natural phytotherapy, for the recovery of different symptoms, such as related diseases, asthma, anxiety, cough, allergies, poisoning, cold, fever, chills, headache, stuffy nose, and some intestinal disorders (Ahmed, 2018) and few publications that address its cultivation.

This way, due to the scarcity of information about the cultivation and management of this species in different environments, more studies are needed to provide the desired effect, for divulgation and better cultivation recommendation to the agriculturists.

So, the objective of this study was to verify how different types of colored photoselective meshes (black, red and blue) influence the germination process of two varieties of Perilla frutescens L, being purple and green.

MATERIALS AND METHODS

The experiment was conducted on the Gragoatá Campus of Universidade Federal Fluminense (UFF), in the municipality of Niterói-RJ, latitude 22º 54' 00" S, longitude 43º 08' 00" W and altitude 8 m, in greenhouse belonging to the Farmácia Viva Phytotherapy Program. The cultivation region has an Aw climate, according to the Köppen classification, referring to a tropical climate with dry winters and rainy summers, with a mean annual temperature of 23ºC and mean annual precipitation of 1,200 mm.

Maximum temperature and relative humidity data were collected using a thermo-hygrometer inside the greenhouse with different photoselective meshes: black, red, and blue, all with 70% shading. The data were collected between 7 and 8 am (analysis timing) every day. The data obtained were treated in EXCEL software and the maximum values for temperature (ºC) and relative humidity (%) were analyzed.

For the sowing of the specie Perilla frutescens L. (purple and green), three 200-cell trays, 100 cells for the purple variety and 100 cells for the green variety, were filled with MecPlant substrate and received one seed per cell and were conditioned in the different greenhouses. Sowing was in August 2022 and grown until 22 days when germination stabilized. For irrigation, a daily average of 100ml was maintained.

The germination rate was checked daily, until twenty-second day after sowing, when the treatments stabilized. The germination percentage and the germination speed index (GVI) were determined from the data collection. The germination percentage was calculated by the formula proposed in the Rules for Seed Analysis (BRASIL, 2009) and the GVI according to the equation (EQ(1)) proposed by Maguire (1962) adapted from Moraes et al. (2012).

$$GVI = (G_1/N_1) + (G_2/N_2) + ... + (G_n/N_n) \qquad EQ(1)$$

Where:

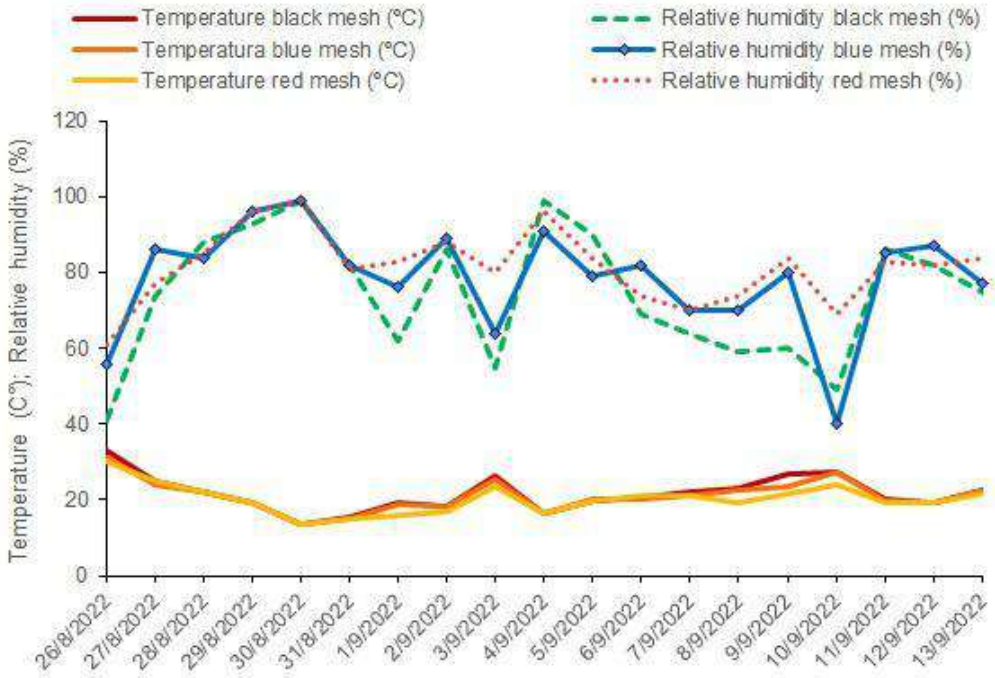
G_1, G_2, G_n= number of seeds germinated at first, second and last count.

N_1, N_2, N_n= days after sowing on the first, second and last count.

RESULTS AND DISCUSSION

Analyzing the climatological data obtained during the experimental period (August and September 2022), regardless of the type of greenhouse in which the germinations occurred (blue, black and red mesh), a constancy in temperature and relative humidity was obtained. Only in the greenhouse with black mesh occurred the highest average in the maximum internal temperature, being 21.66 ºC, and the red with the highest average in relative humidity, being 81.58% (Figure 1).

Figure 1: Temperature and relative humidity inside the greenhouse with 70% shade (black, blue and red meshes) during the experimental period (August and September 2022), Gragoatá Campus - UFF - Niterói (RJ).

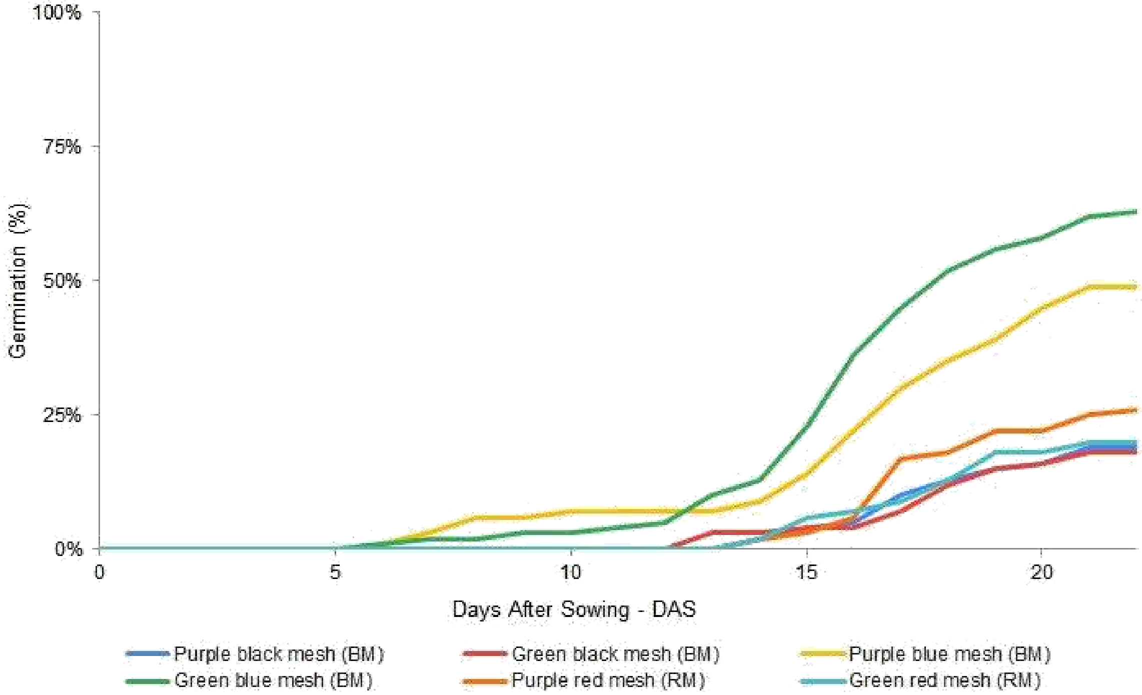


Regarding germination, independently of the location where the trays were grown with the seeds for germination, all took a while to germinate, and with great discrepancy in relation to the days of onset of germination, since they were at six, thirteen, and fourteen days after sowing (DAS), for the blue (Figure 2 A and B), black and red meshes, respectively, stabilizing at 22 DAS in all, regardless of variety. No pictures are available for the others greenhouses, red and black, because they died days after the plantlets were established.

Figure 2: Plants of shisô, blue shading, purple (A) and green (B) varieties during the experimental period, Campus Gragoatá - UFF - Niterói (RJ).

The use of colored meshes positively influenced the germination of the two varieties of shiso, due to the use of meshes of different colorations can alter the spectral quality of radiation and thus growth and production (Pinheiro et al, 2012). The best response was verified in the blue mesh, in which both varieties began germination together, but the green variety had greater germination in this environment, as can be observed in Figure 3. Regarding the germination of the two varieties inside the greenhouse with red mesh, the opposite was verified in relation to the highest percentage of germination, being for the purple variety in this treatment. For the greenhouse with black mesh, the highest percentage of germination was for the green variety, at the beginning and later finishing with the purple variety, the highest percentage.

Figure 3: Germination of the different treatments until stabilization at 70% shading (black, blue and red meshes).



The seeds from the black mesh treatment obtained the lowest germination percentage, in both varieties, possibly due to the environmental conditions they were subjected to in that greenhouse, since the sensitivity of seeds to light is quite variable, with seeds whose germination is positively or negatively influenced by light during the germination process (Stefanello et al., 2015). The seeds of this treatment germinated with a delay when compared to the blue shaded treatment.

The total average of germination percentages for the seeds in the black mesh treatment was 5% for both varieties, in the blue mesh treatment it was 18% for the purple variety and 23% for green. In the red mesh treatment, the germination percentage was only 7% for the purple variety and 6% for green.

As for the IVG, the highest index was verified in the blue mesh treatment for both varieties, followed by the red mesh treatments and lastly the black mesh treatments. The germination speed indexes were: (i). 20 (blue mesh, purple variety); (ii). 24.8 (blue mesh, green variety); (iii). 5.4 (black mesh, purple variety); (iv). 5.3 (black mesh, green variety); (v). 7.3 (red mesh, purple variety); and (vi). 5.9% (red mesh, green variety).

The positive alteration in the germination process of the blue mesh, but very inferior when related to other types of seeds, due to the meshes altering the radiation spectrum (Oliveira et al., 2021), which internally reaches the ambient where the germination process happens.

CONSIDERATIONS

In relation to the different types of colored photoselective meshes (black, red and blue), growing the varieties (purple and green) under 70% blue shading showed the biggest adaptation and positive influence for germination. This result was followed by red and black shading, respectively, for both shiso varieties.

PRESENTATION: https://youtu.be/AlgVFKaagaQ

REFERENCES

AHMED, HIWA M. Ethnomedicinal, Phytochemical and Pharmacological Investigations of Perilla frutescens (L.) Britt. **Molecules**. v. 24(1), n. 102, p. 1-23, 2018.

BRASIL. Ministério da Agricultura, Pecuária e Abastecimento. **Regras para análise de sementes. Ministerio da Agricultura, Pecuaria e Abastecimento**. Secretaria de Defesa Agropecuaria. Brasilia: MAPA/ACS, p. 395, 2009.

MAGUIRE, J. D. Speed germination-aid in selection and evaluation for seedling emergence and vigor. **Crop Science**, v. 2, p. 176–177, 1962.

MORAES, D. M.; BANDEIRA, J. M.; MARINI, P.; LIMA, M. G. S.; MENDES, C. R. **Práticas laboratoriais em fisiologia vegetal**. Editora Copias Santa Cruz Ltda, 2012. v. 1, 162p. 2012.

OLIVEIRA, L. G. C.; LIMA, C. S. M.; BONOME, L. T. S.; ROSA, G. G. Malhas de sombreamento e concentrações de ácido salicílico no cultivo de cenoura em sistema orgânico de produção. **Revista Iberoamericana de Tecnología Postcosecha**, v. 22, n. 1, 2021.

OMER, E. A.; KHATTAB, M. E.; IBRAHIM, M. E. First cultivation trial of Perilla frutescens L. in **Egypt. Flavour Fragr. J.** v. 13, p. 221-225, 1998.

PANDEY, A; BHATT, K. C. Diversity distribution and collection of genetic resources of cultivated and weedy type in Perilla frutescens (L.) Britton var. frutescens and their uses in Indian Himalaya. **Genet Resour Crop Evol**, 01 Sep 2008, 55(6):883-892. DOI: 10.1007/s10722-007-9293-7

PINHEIRO, R. R.; SCHMIDT, D.; CARON, B.O.; BOSCAINI, R. Efeito de diferentes malhas de sombreamento na emergência e produção de mudas de rúcula. **Enciclopédia Biosfera,** Centro Científico Conhecer, Goiânia, v.8, n.15, p.757-766, 2012.

STEFANELLO, R; NEVES, L.A.S.; ABBAD, M.A.B.; VIANA, B.B. Germinação e vigor de sementes de chia (Salvia hispanica L. - Lamiaceae) sob diferentes temperaturas e condições de luz. **Rev. Bras. Pl. Med.,** Campinas, v.17, n.4, supl. III, p.1177-1181, 2015.

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GREENHOUSE MONITORING PROJECT WITH NODEMCU ESP8266

Mayra Borges Williams [1], Daniela Rogonsky da Costa [1], Ivanovich Lache Salcedo [1], Flávio Castro da Silva [1]

[1] Federal Fluminense University - UFF, Brazil (Mayraborges@id.uff.br)
[2] Federal Fluminense University – UFF, Brasil

Abstract

Currently, one of the biggest objectives within the field of agricultural technology is the monitoring of variables (such as air and liquid temperature or air humidity and luminosity) through technological tools in order to guarantee the quality of the development of greenhouse crops and avoid both agricultural waste and financial losses. Although crucially important, the implementation of such technological tools is limited by their high cost. Consequently, it has become necessary to develop affordable monitoring solutions for communities that have budgetary limitations. Thus, the objective of this project is to develop a low-cost system of easily acquired materials, capable of monitoring these variables in greenhouses - giving smaller producers access to vital technology. And according to research, the proposed system could significantly reduce labor and operating costs while increasing production and profitability - offering both meaningful and sustainable change (KYAW and NG, 2017). Through the NODEMCU ESP8266 device and the sensors and devices connected to it, together with the use of the Arduino platform, it was possible to develop a system capable of collecting data such as: air temperature and humidity, liquid temperature, luminosity and liquid flow from houses vegetation. Together they make it possible to perform accurate monitoring and make adjustments when necessary. The project was developed at the Universidade Federal Fluminense, on the Praia Vermelha campus. The microcontroller was developed involving knowledge in the areas of programming, electronics, mathematics, physics and Agricultural and Environmental Engineering.

Keywords: Monitoring, greenhouses, NodeMcu ESP8266

INTRODUCTION

Brazil is the third largest agricultural producer and the second largest agricultural exporter in the world. The agro sector is responsible for being a quarter of the GDP (Gross Domestic Product) of the country. When analyzing the agro GDP, agriculture accounts for 68% in total. (FieldView™ Team - 2021)

According to former minister Luis Carlos Guedes, agriculture is a high-risk economic activity because it depends on external factors independent of human activity, such as climate change and the emergence of pests. One of the alternatives to overcome these contingencies is investment in greenhouses to maintain the best conditions for the plants by retaining heat from sunlight and controlling both the temperature and internal humidity.

Over the years, technology in agriculture has evolved to the point of reaching the so-called agriculture 4.0 - commonly known as precision agriculture. This advance helped studies focused on remote monitoring in smart greenhouses, with the objective of real-time analysis of such climate variables mentioned above. This allows for better and more efficient management of agricultural crops in order to make agribusiness grow equitably and sustainably.

Based on the ideas presented, this project emerged with the aim of making the monitoring of smart greenhouses a reality accessible to researchers and small producers using a hardware named NodeMcu ESP8266.

Arduino is a family of low-cost microcontrollers capable of interacting with the environment through sensors, reading the data captured by them and transmitting such information to the Serial Monitor present in the NodeMcu ESP8266 programming software - the Arduino IDE. Arduinos work similar to a small computer capable of interpreting inputs and controlling outputs in order to create automatic systems.

MATERIALS AND METHODS

In this project, the NodeMcu ESP8266 is used, together with the DHT22, LDR, YF-S201b, DS18B20 sensors and the Memory Card, LCD and DS1307 RTC data loggers.

NodeMcu is a development board that combines the ESP8266 chip, a usb-serial interface and a 3.3V voltage regulator. Programming can be done using LUA or the Arduino IDE, using communication via micro-usb cable, this microchip has built-in WiFi and low power consumption.

DHT22 is the temperature and relative humidity sensor, with a temperature range from -40°C to 125°C and a humidity range from 0% to 100%.

LDR is the brightness sensor, it is a type of resistor that has the ability to vary its resistance depending on the intensity of light that falls on it. Like common resistors, LDR has no polarity and its resistance is measured in ohms.

YF-S201 is the liquid flow sensor that serves to measure the amount of water that passes through the stove, monitoring the daily, weekly, monthly and annual consumption of the system. The water flow measurement range is 1-30 L per minute and its maximum pressure is up to 1.75 MPa. (Amir Mohammad Shojaei, Electropeak)

DS18B20 is a liquid temperature sensor, but it also works in dry and humid environments, taking measurements in the range of -55° to 125°C. It has a One-Wire protocol, that is, its communication is done through a single data wire, in addition to the VCC and GND, it has its own 64-bit ID code. (Caroline Locatelli, 2021)

DS1307 RTC (Real Time Clock), SD Card (Memory Card) and LCD (Liquid Crystal Display) are classified as electronic components to help capture and record data collected by the aforementioned sensors. The DS1307 RTC provides seconds, minutes, hours, day, date, month and year information to the microcontroller allowing the microcontroller to record hours and to program actions to be performed at certain times, this model has a lithium battery providing the record time without directly relying on electrical energy. The SD Card is used to store data obtained by the sensors, when connecting the memory card to a computer, files in TXT format will be obtained. The LCD displays the desired information on a 16×2 pixel matrix screen.

RESULTS AND DISCUSSION

Water resources are an important and concerning issue in modern societies and economies. That is why there is a great demand for devices capable of interpreting the dynamics of water in the soil and allowing for the full use of its resources. Cultivation techniques that aim to contribute to the efficient use of water are also essential and among these cultivation techniques, hydroponics has a great production potential, in addition to the need for less water associated with traditional planting, according to Van Ginkel et al. (2017).

Therefore, hydroponics associated with automation using an Arduino or NodeMcu microcontroller has brought very satisfactory results for agriculture, according to Marcelo Anderson Carlet's master's thesis.

With the aforementioned sensors installed on the NodeMcu ESP8266 board (R$26.91), we were able to collect information such as temperature and relative humidity with the DHT22 (R$39.90), solar incidence with an LDR (R$0.54), daily, weekly, monthly and annual water flow with YF-S201 (R$43.75), liquid temperature with DS18B20 (R$16.90), time record with DS1307 RTC (R$9.50), annotation of all data on the memory card (R$48.58) and transmission of information to the LCD (R$18.90).

By installing all the sensors on the NodeMcu ESP8266 board, the expected result was obtained of collecting the necessary data and transmitting them to the LCD for quality monitoring of the hydroponics greenhouse located at the Universidade Federal Fluminense, on the Praia Vermelha campus.

The primary goals of the project were - in addition to installing the monitoring system in the hydroponic lettuce greenhouse - to bring new low-cost technologies into the university to then complete the study and finally share it with Brazilian society, especially smaller rural producers. As a result, financially accessible technological methods were produced within the project in accessible language. This study believes that every project produced within the public university should have these same goals in common. According to Grace Hopper - computer scientist, pioneer in computing - the human being must transform information into intelligence or knowledge.

CONSIDERATIONS

With that, the objective of the project is to be able to bring the possibility of a 4.0 agriculture equipment to the smaller producer, carrying out the monitoring of their cultures with high precision and low investment cost - because in total less than R$210 was spent to structure this system - had been successfully reached.

PRESENTATION: https://youtu.be/T1ZINB35PLY

REFERENCES

EQUIPE FIELDVIEW™. **Qual a participação do agronegócio no PIB brasileiro?** Available at: https://blog.climatefieldview.com.br/qual-e-a-participacao-do-agronegocio-no-pib-e-nas-exportacoes-brasileiras. Access on: 18 Oct. 2022

MIHAI, Bogdan. How to use the DHT22 sensor for measuring temperature and humidity with the Arduino board. **Science**. Available at https://sciendo.com/downloadpdf/journals/aucts/68/1/article-p22.pdf. Access on 18 Oct. 2022

SHOJAEI, Amir Mohammad. Interfacing YF-S201 Transparent Water Flow Sensor with Arduino. **Electropeak**. Available at: https://electropeak.com/learn/interfacing-yf-s201-transparent-water-liquid-flow-sensor-with-arduino. Access on: 20 Oct. 2022

LOCATELLI, Caroline. **Como utilizar o DS18B20.** Curto Circuito. Available at: https://curtocircuito.com.br/blog/Categoria%20Arduino/como-utilizar-o-ds18b20#:~:text=O%20sensor%20tem%20Protocolo%20One,barramento%2C%20poupando%20espa%C3%A7o%20do%20m Access on: 20 Oct. 2022

KYAW, Thu Ya and NG, Andrew Keong. **Smart Aquaponics System for Urban Farming**. Available at:

https://reader.elsevier.com/reader/sd/pii/S1876610217364585?token=9D5A8F9734956A81AA5CC87FDDDF3C94A1F3406C8604C70FD6DCFDD2BFEDF135613BF67E935759B6494E4CFBF0east-1&originCreation=20221020181439. Access on: 20 Oct. 2022

CARLET, Marcelo Anderson. **Automação de horta hidropônica utilizando microcontrolador Arduino**. Available at: https://repositorio.utfpr.edu.br/jspui/bitstream/1/25460/1/automacaohortahidroponicamicrocontrolador.pdf. Access on: 20 Oct. 2022

MAJOR HEAVY METALS FOUND IN URBAN WETLANDS: A REVIEW

Pedro Soares de Melo [1], Anna Amandi Palma Diniz Baker [2], Gabriel Brazo Sabino da Silva [3], Julia Ramos de Oliveira [4], Giselle de Souza da Fonseca [5], Junior Borella [6], Cristina Moll Hüther [7]

[1] Undergraduate at Agricultural and Environment Engineering – UFF, Niterói-RJ – (corresponding author: pedrosm@id.uff.br)
[2] Undergraduate at Agricultural and Environment Engineering – UFF, Niterói-RJ (amandianna@id.uff.br)
[3] Undergraduate at Agricultural and Environment Engineering – UFF, Niterói-RJ (gbrazo@id.uff.br)
[4] Undergraduate at Agricultural and Environment Engineering – UFF, Niterói-RJ (jroliveira@id.uff.br)
[5] Undergraduate at Agricultural and Environment Engineering – UFF, Niterói-RJ (gisellesouza@id.uff.br)
[6] Prof. at the Botanic Department - FURG, Rio Grande, RS (borellaj@gmail.com)
[7] Prof. at Agricultural and Environment Engineering Department - UFF, Niterói-RJ (cristinahuther@id.uff.br)

Abstract

With the development of civilizations and the growth of sustainable ideals, water, an essential element of many human activities, has become a central focus of studies. Effects such as salinization and eutrophication of water bodies due to pollutants, such as heavy metals, injected by industrial waste and sanitation of such urban environments are increasingly evident. Thus, the present work aimed to verify the state of the art of international publications in the last ten years related to pollutants found in urban wetlands treated with phytoremediation, focusing on heavy metals and how they can contribute to possible impacts on human health. For this, a literature survey was conducted from January 2011 to December 2022, using the search terms “wastewater” and “phytoremediation” in SciELO, MDPI, Elsevier and ScienceDirect. Within 19 articles analyzed, the main pollutants filtered by plants in wetlands are the heavy metals Lead and Chromium, followed by the elements Cadmium, Copper, Zinc and Nickel that were found in close proportions. In addition to Selenium, Mercury, Arsenic, Iron, and Magnesium.

Keywords: Health, Pollutants, Water, Impact Environmental, Industrial waste

INTRODUCTION

Water is an essential element for activities that ensure human life, such as agriculture and animal husbandry, however, the intensification of industrial activities in urban areas has caused serious environmental problems due to the discharge of untreated effluents into water bodies (CHEN et al., 2022).

The United Nations (UN), aiming to solve this problem and ensure life quality for society, developed a program with 17 Sustainable Development Goals (SDGs) to be accomplished by 2030 to achieve basic human rights. Among the established goals can be mentioned the intention to improve water quality by reducing pollution, eliminating dumping and minimizing the release of chemicals and hazardous materials in conjunction with substantially reducing the number of deaths and diseases from air and soil water contamination, and pollution.

Studies prove that heavy metals can interfere in the food chain, because vegetables and primary consumers can bioaccumulate this material generating a food safety and endangering human health (XU et al., 2022). About 58% of health problems, such as diarrhea, are caused due to the ingestion of contaminated water or food, which were a consequence of industrial and domestic effluents discharged into the environment without prior treatment (KAFLE et al., 2022).

Thus, the present work aimed to verify the state of the art of international publications in the last ten years related to pollutants found in urban wetlands with a focus on heavy metals and how these can contribute to possible impacts on human health.

MATERIALS AND METHODS

A bibliographic survey of the pollutants present in degraded urban wetlands as a result of the waste material dumping with improper treatment by industries, in addition to domestic effluents, and that aquatic plants were being used in the site for recovery.

Thus, in this study 19 selected articles were analyzed, in which the selection criteria required was that the terms “wastewater” and “phytoremediation” were present in one of the following components of the article formation: title, abstract, or keywords. In addition to these composition criteria, the articles had to be published between January 2011 and December 2022.

The literature search was done through SciELO, MDPI, Elsevier, and ScienceDirect websites. The selected articles were registered in an Excel spreadsheet for further data analysis.

Subsequently, all the heavy metals mentioned in the totality of the articles were registered, aiming to understand which ones are commonly found in these situations and noting how many of these articles mentioned the same heavy metal, seeking to understand the frequency that the same pollutant is found in the environment. And with this data, a literature review was done searching for possible impacts to human health that such compounds could cause.

RESULTS AND DISCUSSION

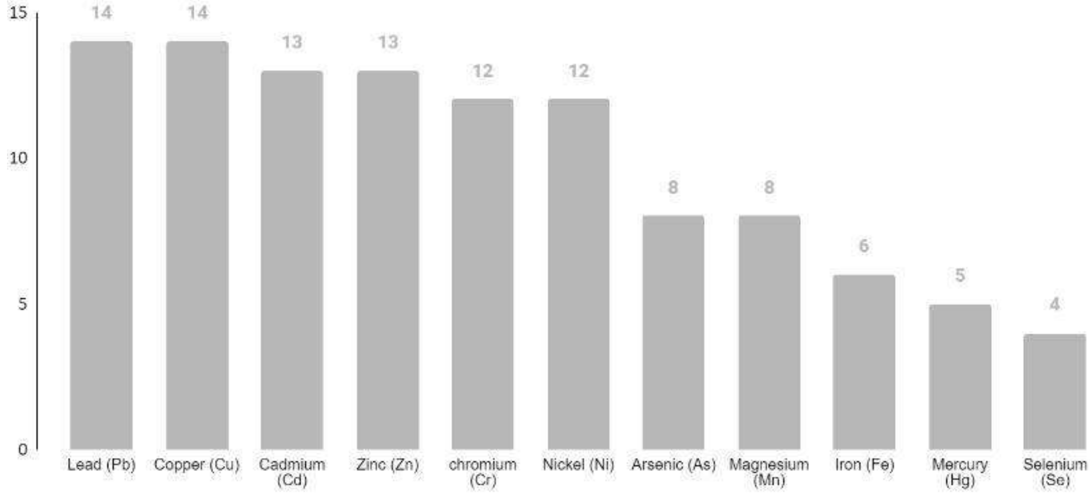
Water bodies near cities have suffered greatly from the process of eutrophication due to dissolved and suspended impurities previously poured in them (JORDAAN; BEZUIDENHOUT, 2013). This fact increases the level of elements such as Nitrogen and Phosphorus in the waters, which propiates the increase of microalgae that make the gas exchange with the atmosphere impossible and ends up reducing the oxygen content found at the site (KUMAR; CHOPRA, 2017). Among these pollutants found in municipal wastewater are examples, detergents, soaps, vegetable oil, food waste, feces, urine and organic substances (MUSTAFA; HAYDER, 2021).

Some compounds can even be classified as Endocrine Disrupting Compounds (EDCs), which by The Endocrine Society's definition is a mixture of chemicals that can cause interference with the hormones of living beings (POLIŃSKA et al. 2021). Examples of these products are pesticides, industrial chemicals, and even pharmaceutical and personal care products.

In this work, the conducted survey demonstrates that of the heavy metals cited in the 19 articles used about wastewater from urban effluents treated by the phytoremediation method showed that the most commonly found pollutants were cadmium (Cd), lead (Pb), chromium (Cr), copper (Cu), zinc (Zn), nickel (Ni) and selenium (Se), which in accordance with what was also addressed by ANSARI et al., 2020. Furthermore, Kafle et al. (2022) adds Iron (Fe), Magnesium (Mn), Mercury (Hg) and Arsenic (Ar), as pollutants present due to these degradation processes.

As can be seen in Figure 1, Lead and Copper were cited in 14 articles, while Cadmium and Zinc were cited in 13 articles, and the rest of the chemical elements were cited as potential pollutants, but with less recurrence.

Figure 1: Major heavy metals found in degraded urban wetlands, and the frequency of mentions referring to these pollutants in the articles evaluated from 2011 to 2022.



Although Cu, Zn, Mn, and Fe can be classified as nutrients used in the metabolism of living organisms, these can be harmful to health if overexposed. The other heavy metals can be toxic even at low concentrations (OLOWOYO et al., 2022). Due to the biological half-life process, defined as the time it takes for the body to discard the chemical by half, concentrations are variable depending on the tissue or organ that has been affected, so it is possible that it takes time to be excreted and brings more severe damage and chronic inflammation (STARK et al., 2022).

This category of material interferes negatively in organisms, since it presents as one of its characteristics the ability to bind with other elements present in the body, such as oxygen, leading to create disorders and modifications in the molecular structure (NELSON; COX, 2014; WU et al., 2016). This issue causes the loss of enzymes and proteins functionality due to an alteration in their conformational structure, which prevents them from performing the expected activities (TAMÁS et al., 2014).

The heavy metals Cd, Cr, Pb and As are potential causes of cellular oxidative stress and carcinogenesis due to long exposures, caused by the time it takes for the body to excrete the substance. The high concentration and residence time in the body of these chemical elements added to Hg, motivates the possibility of neurological damage, DNA damage, and changes in glucose and calcium metabolism (STARK et al., 2022).

Examples of effects that can be observed due to such exposure are, in the case of lead, poor development in the bone system such as osteoporosis or damage to the nervous system. Mainly, due to the fact that lead has a similarity with calcium and ends up creating a competition and substitution within the cells (DE PAULA, 2006). Another case that can be mentioned is that the ingestion of Cr can cause lung cancer, as well as the metals Cu, Mn, Zn, Cd can cause kidney damage and cancer risk (CHEN et al., 2022).

CONSIDERATIONS

Regardless of the chemical substance among those addressed in this paper, once it is in excess condition in urban wetlands, it becomes potentially toxic to human health. Therefore, the accumulation of these substances in water bodies makes their bioaccumulation and direct consumption/contact by the population plausible, which can lead to diseases and dysfunctions in the human body.

Due to the risk of toxicity by discharge in effluents, it is essential to monitor all waterbody, liquid waste, and water supplied to the population, focusing on the most common heavy metals found in urban wetlands and ensuring that they do not reach other waterbody, as well as contributing to the access to water quality for the population.

PRESENTATION: https://youtu.be/Tw1ltlREV9M

REFERENCES

CHEN, J. et al. Health Risk Assessment of Heavy Metals in Shallow Groundwater of Coal–Poultry Farming Districts. International **Journal of Environmental Research and Public Health**, v. 19, n. 19, p. 12000, 22 set. 2022.

DE PAULA, M. Invisible enemy: Heavy Metals and human health. **Tchê Química**, v. 3, n. 6, ago. 2006.

JORDAAN, K.; BEZUIDENHOUT, C. The impact of physico-chemical water quality parameters on bacterial diversity in the Vaal River, South Africa. **Water SA**, v. 39, n. 3, 3 jul. 2013.

KAFLE, A. et al. Phytoremediation: Mechanisms, plant selection and enhancement by natural and synthetic agents. **Environmental Advances**, v. 8, p. 100203, 1 jul. 2022.

KUMAR, V.; CHOPRA, A. K. Phytoremediation potential of water caltrop (Trapa natans L.) using municipal wastewater of the activated sludge process-based municipal wastewater treatment plant. **Environmental Technology**, , v. 39, n. 1, p. 12–23, 2 jan. 2017. http://dx.doi.org/10.1080/09593330.2017.1293165

MUSTAFA, H. M.; HAYDER, G. Recent studies on applications of aquatic weed plants in phytoremediation of wastewater: A review article. **Ain Shams Engineering Journal**, v. 12, n. 1, p. 355–365, 1 mar. 2021.

NELSON, D. L.; COX, M. M. **Princípios de Bioquímica de Lehninger**. 6. ed. Porto Alegre: Artmed, 2014.

OLOWOYO, J. O. et al. Concentrations of Pb and Other Associated Elements in Soil Dust 15 Years after the Introduction of Unleaded Fuel and the Human Health Implications in Pretoria, South Africa. **International Journal of Environmental Research and Public Health**, v. 19, n. 16, p. 10238, 18 ago. 2022.

POLIŃSKA, W. et al. Insights into the Use of Phytoremediation Processes for the Removal of Organic Micropollutants from Water and Wastewater; A Review. **Water** 2021, Vol. 13, Page 2065, v. 13, n. 15, p. 2065, 29 jul. 2021.

STARK, A. A. P. et al. Heavy metals and their relationship to oxidative stress in reptiles. **Research, Society and Development**, v. 11, n. 3, p. e27511326571, 21 Feb. 2022.

TAMÁS, M. J. et al. Heavy Metals and Metalloids As a Cause for Protein Misfolding and Aggregation. **Biomolecules** 2014, Vol. 4, Pages 252-267, v. 4, n. 1, p. 252–267, 25 fev. 2014.

WU, X. et al. A review of toxicity and mechanisms of individual and mixtures of heavy metals in the environment. **Environmental Science and Pollution Research** 2016 23:9, v. 23, n. 9, p. 8244–8259, 11 mar. 2016.

XU, Z. et al. Heavy Metal Pollution and Health Risk Assessment of Vegetable–Soil Systems of Facilities Irrigated with Wastewater in Northern China. **International Journal of Environmental Research and Public Health**, v. 19, n. 16, p. 9835, 10 ago. 2022.

ORGANIC WASTE MANAGEMENT AND COMPOSTING IN THE ACADEMIC COMMUNITY

Andressa Campos da Silva [1], Arthur Valente Ceccon [2], Kamila Lopes Adão [2], Pedro Almeida Soares [2], Raquel Rangel de Moraes Cunha [2], Dirlane de Fatima do Carmo [2], Carlos Rodrigues Pereira [2]

1 Federal Fluminense University – UFF, Brazil (andressacampos@id.uff.br)
[2] Federal Fluminense University – UFF, Brazil

Abstract

The environmental and ecological concerns are closely linked to the waste destination and disposal. In Brazil, most of the organic waste is disposed of with other solid waste in landfills and dumping grounds, only 0,4% designated to the composting process. Composting is a process of anaerobic decomposition, in a stabilized way, of organic materials seeking to obtain a humic compound as a final product that can be used for soil nutrition. The present work aims for a case study on the implementation of an organic waste management project for composting within the academic community. For this purpose, were developed advertising and marketing materials, where the main goal is to create the university version of the Bucket Revolution Project, involving the academic community. Alongside the material, different size bins were implemented in strategic places across the campus and used as Volunteer Delivery Points (PEV). Additionally, it was developed a homemade compost bin, so that it can be moved and used as a teaching device. The implementation of a composting system on a local scale, in the university laboratory can significantly reduce the disposal of organic waste in landfills, encourage sustainable thinking and acting, besides providing a study case for the students.

Keywords: Composting; Organic Waste; Agroecology; Bucket Revolution Project; Social Management; Urban Agriculture.

INTRODUCTION

Most organic waste produced in Brazil are disposed of in controlled landfills and dumping grounds, and only 0.4% of the collected mass of urban solid waste is designated for the composting process, which corresponds to 246,405 tons per year (BRASIL, 2019 apud SNIS, 2019). For Inácio and Miller (2009 apud ABREU, 2013), organic recycling consists of waste management that contributes to a greater awareness of society and control of environmental pollution. Decentralized organic residues management in small communities has proven to be an effective way of improving residues flow and implementing a sustainable food system (Pope, 2020).

Composting is a process of controlled biological decomposition of organic waste, fulfilled by a diverse population of organisms, that occurs under aerobic and thermophilic conditions, resulting in a stabilized material, (CONAMA 481, 2017) and can be considered a fundamental tool for reducing organic waste, providing, as a final product, a fertilizer rich in nutrients for the soil. The composting process has been increasing its acceptance as a key element of integrated waste management. (Behrooznia et al., 2018; Lin et al., 2018). Though composting has advantages and disadvantages, the advantages overcome the disadvantages, considering composting consists in a fast degradation of waste and a relatively small investment, yet requires a large area of implementation and may result in gaseous emissions which add to greenhouse effects, air and odour pollution and leachate production (Kumar, 2011; Jiang et al., 2015; Lin et al., 2018)

The Revolucao dos Baldinhos (the Bucket Revolution Project (BRP)) emerged from the need to solve public health problems caused by the accumulation and dispersion of garbage in the community called Complexo Chico Mendes, southern Brazil. Created in 2009, the PRB consists in the decentralized management of solid waste, so that the local population performs selective collection within their homes, allocating organic waste for composting, whose produced compost returns to their homes and is used for urban agriculture.

Thus, the present work aims for a case study on the implementation of an organic waste management project for composting within the academic community.

MATERIALS AND METHODS

The Bucket Revolution Project emerged from the need to solve public health problems caused by the accumulation and dispersion of garbage in the community called Complexo Chico Mendes. The PRB consists in the decentralized management of solid waste, so that the local population performs selective collection within their homes, allocating organic waste for composting, whose produced compost returns to their homes and is used for urban agriculture.

The composting project of PET Engenharia Agrícola e Ambiental, called CompostUFF, has as its main objective to implement the PRB at Campus Praia Vermelha, involving the academic community for the management of domestic organic waste, enabling and executing composting as a possible alternative. Aiming at training and including the academic community in the project, the specific objectives include the generation of dissemination and guidance material on the project and the composting process, identification of the points of greatest generation of organic waste and the availability of Volunteer Delivery Points (PEV) on campus and build compost bed that could be used for research, education and outreach programs.

To build the training and dissemination material, a bibliographical survey on the theme was carried out, using the terms composting, home composting, organic waste treatment, and sustainability, with a time frame of 25 years, searching the SciELO, Google Scholar, and Infoteca-e databases.

The survey of the areas with the highest waste generators was focused on food selling areas, such as canteens and restaurants, in a manner that they are ideal locations for the voluntary delivery points. In addition, the implementation of a larger scale collection point near the composting area is ideal for both logistics and the direct contact of the academic community with the project itself.

The implementation of the experimental composting beds takes place in the Laboratório de Práticas Agrícolas (LABPAS) at the UFF Praia Vermelha campus, with the intention of generating products that can be used in other projects in the area.

RESULTS AND DISCUSSION

The ebook named Cartilha: Compostagem - CompostUFF, is available online, in PDF format, and can be found on PET's social networks. However, taking into account the initiative within the university, brochures and posters were created for advertising, containing a QR code so that it can be accessed directly with a cell phone.

Figure 1: CompostUFF brochure

Figure 2: Posters used

Aiming at the wider dissemination of composting, the project also has a small-scale and homemade compost bin, with the use of buckets, and is displayed near the PET Agrícola room, in block E of the Praia Vermelha campus. Next to the compost bin there is a small collection point and posters with essential information about the project. The PET compost bin is already active and can even be used in university extension events.

The Collective Delivery Points consist of medium and large containers, the larger ones located near the project implementation area and the smaller ones at strategic points. In addition, each container carries a poster sticker indicating what can and cannot be placed in the compost bin.

CONSIDERATIONS

The Bucket Revolution Project makes it possible to understand the importance of the dissemination of solid waste management studies and the implementation of a composting system on a local scale. Since it is a simple and low-cost method, it enables its implementation at the university, becoming an alternative for proper disposal of organic waste from members of the academic community. Thus, it is observed that advertising and marketing strategies are essential to promote sustainability and environmental education, in order to popularize the practice of composting and also, due to its great simplicity, that the student body and faculty apply it in their homes.

PRESENTATION: https://youtu.be/Px51gx9yIL4

REFERENCES

ABREU, M.J. **Gestão comunitária de resíduos orgânicos: o caso do Projeto Revolução dos Baldinhos (PRB), Capital Social e Agricultura Urbana**. 2013. Dissertação (Mestrado em Agroecossistemas) - Universidade Federal de Santa Catarina, Santa Catarina, 2013.

BRASIL. Ministério do Meio Ambiente. **Programa Nacional Lixão Zero**. Brasília, DF, 2019. 72 p. (Agenda Nacional de Qualidade Ambiental Urbana, 2).

BRASIL. Ministério do Meio Ambiente, Conselho Nacional do Meio Ambiente - CONAMA, **Resolução nº 481**. Brasília, DF, 2017. 4 p.

MONTEIRO, J. A. V. Benefícios da Compostagem Doméstica de Resíduos Orgânicos. **Revista Educação Ambiental em Ação**, Rio de Janeiro, v. 56, Jun; 2016.

POPE, K. **Global waste management: Models for Tackling the International Waste Crisis**. 1° Edição. Kogan Page, 2020.

LIN, L. XU, F. XUMENG, G. Li, Y. Improving the sustainability of organic waste management practices in the food-energy-water nexus: A comparative review of anaerobic digestion and composting. **Renewable and Sustainable Energy Reviews**. Edição 89, 2018.

M.D. Vaverková et al. Alternative method of composting on a reclaimed municipal waste landfill in accordance with the circular economy: Benefits and risks. **Science of the Total Environment** 723, 2020.