PHYTOMETRY OF COWPEA CULTIVARS USING ORGANIC SUBSTRATES

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ABSTRACT

Cowpea (*Vigna unguiculata* (L.) Walp.) stands out for its nutritional value and adaptability to different environmental conditions, and is widely cultivated in tropical regions. This study evaluated the development of two cowpea cultivars (BRS Imponente and BRS Tracuateua Purified) under different organic substrates, in order to understand the effects of organic fertilization on biomass production and root development. The experiment was carried out in a greenhouse at the Federal Rural University of the Amazon (UFRA), using a completely randomized design with four types of organic fertilization (control, açaí seed, sheep manure and Brazil nut shell). The results showed that the substrate based on açaí seeds favored the development of the cultivars, providing greater production of green mass and greater accumulation of root biomass, especially for BRS Imponente. On the other hand, sheep manure was less efficient for both cultivars. BRS Tracuateua showed greater adaptability to conditions of lower nutritional availability, while BRS Imponente showed better response to substrates richer in organic matter. It is concluded that the choice of substrate significantly influences the performance of the cultivars, and the açaí seed is a promising alternative for the sustainable cultivation of cowpea.

Keywords: Cowpea. Cultivars. Organic fertilization. Substrates. Biomass.

INTRODUCTION

Cowpea grains (Vigna unguiculata (L.) Walp.) have a high protein value and are cultivated mainly in Asian and African countries (FREIRE FILHO et al., 2005). They have good adaptability characteristics to different climates (FREIRE FILHO et al., 2011), which represents the opportune investment in the species in order to produce food of good nutritional value for places where low productivity is constant.

This grain has become essential in the diet of the low-income population in the northern region of Brazil (RODRIGUES et al., 2015).

Cowpea is not very demanding in terms of soil fertility (SAMPAIO; BRASIL, 2009) which does not mean that this crop is not responsive to fertilization and/or irrigation, among other cultural treatments. Therefore, research focused on the physiology and management of fertilization of this plant can contribute to the development of this crop that is so important for Brazil (CAMPANHARO et al., 2013).

The BRS Tracuateua cultivar stands out for the growing incorporation of high technology to its production process, which has required the use of cultivars with a more uniform size, cycle and grains. It is recommended that good soil preparation be carried out, and that acidity correction and fertilization be defined based on the results of the soil fertility analysis. (SAMPAIO; BRAZIL, 2009). In tropical ecosystems, soil organic matter is very important, given that its benefits to soil physics, chemistry and biology, such as: water retention, better aggregation, better CEC, greater availability of nutrients and addition of beneficial microorganisms present in organic material, are fundamental to the good development of plants (ZANDONADI et al., 2014).

The amount of organic matter stored in the soil is determined by the interaction between the factors responsible for its formation and decomposition, for any and all agroecosystems (LEITE et al., 2003). The introduction of organic products into the soil reflects significant improvements for it, which are characterized by the gradual availability of nutrients, contributing to the reduction of processes such as erosion, leaching, volatilization and fixation (ZECH et al., 1997).

According to Junqueira et al. (2000), organic agriculture began to gain greater notoriety and consolidation in the early 60s, due to some questions about the negative effects that the conventional agriculture model provides when handled incorrectly. Such as: dangers to human health from the use of pesticides, reduction of biodiversity, development of plants with little resistance to pest attack, diseases of nutritional imbalance, soils more susceptible to erosion and leaching, and socioeconomic exclusion.

Due to this scenario, the consumption of organic products has shown a growth of 50% per year (SANTOS et al., 2001). This is because the search for a healthier diet based on organic crops is growing, thus the need to use highly productive systems that provide quality, quantity and regularity (FURLANI; PURQUERIO, 2010), which use fertilizers of organic origin in conjunction with alternative pesticides in the control of pests and diseases, in order to avoid chemical residues in products and improve the quality of life of producers and consumers, in addition to preserving nature (MEIRELLES, 1997).

Studies on the use of organic fertilization, in different forms and sources, point to the advantages of its use to improve crop productivity, in addition to its beneficial effects on the chemical, physical and biological characteristics of the soil, and the use of residues from different sources for the production of organic compounds (FINATTO et al., 2013).

In view of this, studies are presented that aim to improve crop performance through the use of organic fertilization, advocating better development of them. Thus, in this work we present the results obtained from a 32-day follow-up study, analyzing the responses and performance of the two cowpea cultivars (BRS IMPONENTE and BRS TRACUATEUA PURIFIED), submitted to different organic substrates in order to discern their behavior.

MATERIAL AND METHODS

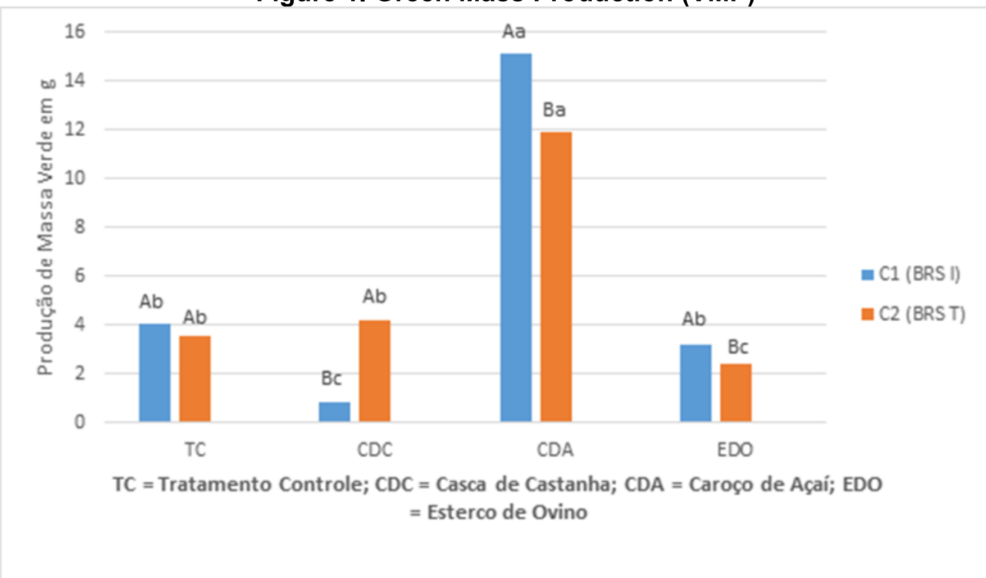
The experiment was conducted in a greenhouse at the Federal Rural University of the Amazon (UFRA), in Belém, Pará, between June and July 2018. The site, located at coordinates 1°27'9'' S latitude and 48°26'28'' W longitude, at 13 meters altitude, has a humid tropical climate (Afi, according to Köppen-Geiger), with average annual rainfall of 2,537 mm, average temperature of 26.8 °C and relative humidity of 84%. These climatic conditions directly influence the dynamics of nutrients in the soil, being relevant for the development of the experiment. The substrate used was prepared from agro-industrial residues, such as Brazil nut shells, açaí seeds and sheep manure, composted in windrows and adjusted to ensure an adequate carbon/nitrogen (C/N) ratio. After maturation, the compost was chemically analyzed to determine its nutrient content.

The experimental design was completely randomized, in a 4x2 factorial scheme, with four replications, totaling 32 experimental units. The factors consisted of four types of organic fertilization (control, açaí seed, sheep manure and formulated organic compost) and two cowpea cultivars (BRS Imponente and BRS Tracuateua). Each experimental unit was composed of 5 dm^3 pots, filled with soil characterized for fertility and texture. The variables analyzed included green mass production, shoot/root ratio, and root fresh mass (FRM), measured with precision scales and millimeter rulers. The data were submitted to analysis of variance and Tukey's test at 5% probability, using the Sisvar 5.6 software.

RESULTS AND DISCUSSION

The analysis of the results related to the production of green mass among the cowpea cultivars (BRS Imponente and BRS Tracuateua) revealed significant differences in response to the different organic fertilization treatments. As illustrated in Figure 1, the cultivar BRS Imponente showed superiority in relation to BRS Tracuateua in the treatments with açaí seed and sheep manure.

Figure 1. Green Mass Production (VMP)



Source: Authors

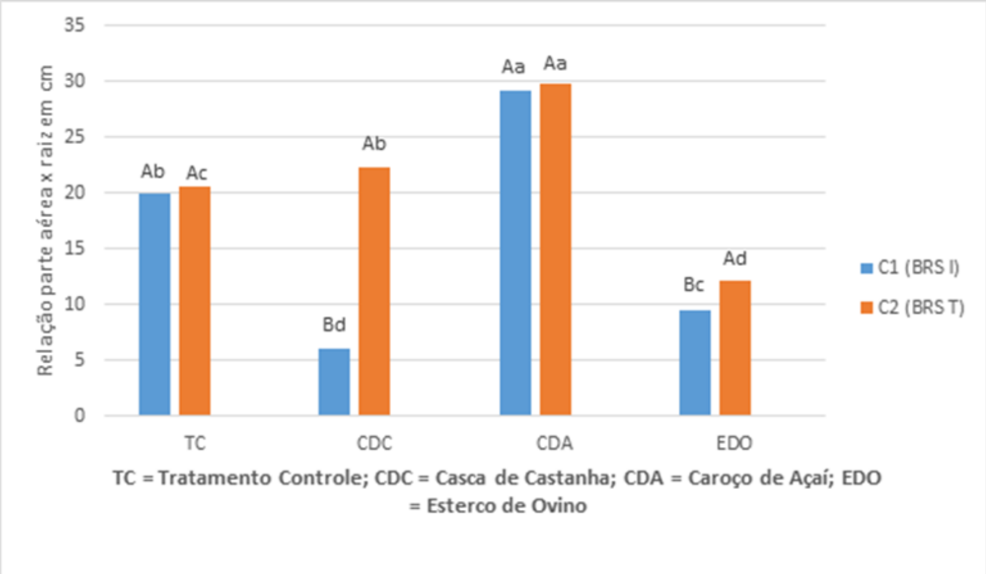
In the control treatment (TC), both cultivars showed statistical similarity, while the nut shell substrate (CDC) was the only one in which BRS Tracuateua surpassed BRS Imponente. These results corroborate previous studies, such as that of Maranhão and Paiva (2010), which evidenced the potential of açaí residue as an efficient substrate for plant growth, highlighting its ability to promote greater development in comparison with other organic materials. In isolation, the cultivar BRS Imponente obtained the best performance in the treatment with açaí seed, with the highest production of green mass (≈ 16 g), followed by the control treatment and sheep manure, which presented statistically similar results. The worst performance for this cultivar was observed in the treatment with nut shell, with yield less than 2 g. On the other hand, the cultivar BRS Tracuateua also responded more favorably to the açaí seed, with significantly higher production compared to the other treatments. However, unlike BRS Imponente, BRS Tracuateua showed similar results between the treatments with chestnut shells and the control, while sheep manure was the least effective, resulting in lower production of green mass.

These results suggest that the açaí seed is a highly efficient substrate for both cultivars, possibly due to its nutrient-rich composition and ability to improve the availability of organic matter in the soil, as observed in recent studies on the use of agro-industrial residues in agriculture (SILVA et al., 2021). The superiority of BRS Imponente in most treatments may be related to its higher nutritional requirement and ability to use substrates richer in organic matter. BRS Tracuateua showed greater adaptability to the nut shell substrate, indicating a possible tolerance to less favorable conditions, although it showed poor performance with sheep manure.

The data obtained reinforce the importance of adequate selection of organic substrates to optimize the growth and yield of cowpea cultivars. The açaí seed stood out as the best option for both cultivars, while the sheep manure was less efficient, especially for BRS Tracuateua. These findings are in line with current research that highlights the relevance of using agro-industrial waste as a sustainable alternative to organic fertilization, contributing to the improvement of soil quality and plant development (CARVALHO et al., 2020).

The analysis of the development of the shoot and root system of cowpea cultivars (BRS Imponente and BRS Tracuateua) in response to the different organic fertilization treatments revealed significant differences, as illustrated in Figure 2. The cultivar BRS Tracuateua showed a satisfactory development of the shoot and root in all treatments, with emphasis on the açaí seed (CDA), followed by the control treatment (TC), chestnut shell (CDC) and sheep manure (EDO). On the other hand, the cultivar BRS Imponente showed lower development compared to BRS Tracuateua, except in the control treatment and with açaí seeds, where the results were statistically similar between the two cultivars.

Figure 2. Shoot-root ratio between cultivars under different organic treatments.



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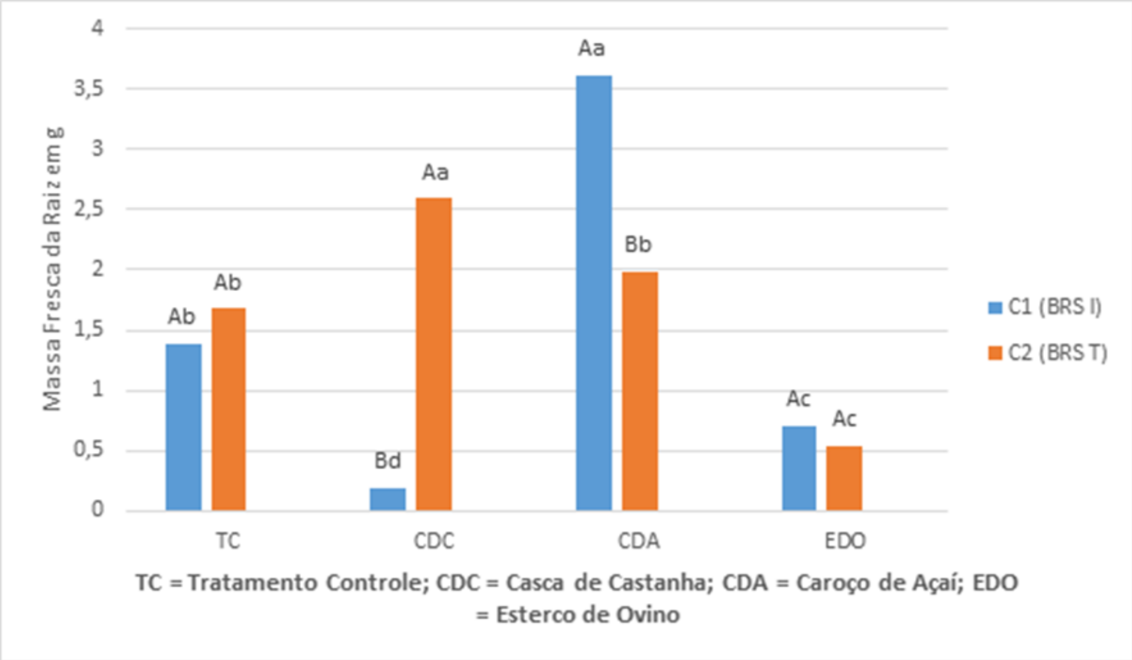
The results found corroborate recent studies, such as that of Erlacher et al. (2016), which highlighted the significant influence of different substrates on plant growth, especially those based on açaí seeds, which proved to be effective in the development of seedlings.

In the unfolding of the treatments, BRS Imponente presented the best results with the açaí seed and the control treatment, which were statistically similar. Next, the treatments with sheep manure and nut shells also showed similar results, but lower than the first two. These data corroborate current research that shows the potential of the açaí seed as a substrate rich in nutrients and capable of promoting an adequate balance between the shoot and the root system (SILVA et al., 2021). In addition, the superiority of BRS Tracuateua over BRS Imponente in most treatments may be associated with its greater adaptability to different substrate conditions, as observed in studies that highlight genetic variability as a determining factor in plant response to different environments (CARVALHO et al., 2020).

The results demonstrate that the açaí seed is an efficient substrate for the development of both cultivars, with emphasis on BRS Tracuateua, which showed greater adaptability to different treatments. BRS Imponente, on the other hand, proved to be more dependent on substrates rich in organic matter, such as açaí seeds, to achieve a satisfactory development. These findings reinforce the importance of proper selection of organic substrates to optimize the growth and productivity of cowpea cultivars, contributing to more sustainable and efficient agricultural practices.

The analysis of the fresh root mass (FRM) of cowpea cultivars (BRS Imponente - C1 and BRS Tracuateua - C2) under different organic treatments (Figure 3) revealed distinct patterns of root development. The cultivar BRS Imponente showed the highest MFR in the treatment with açaí seed (ADC), with average values close to 3.5 g, followed by sheep manure (EDO), with an average of 2.5 g. However, its performance was significantly lower in the nut shell treatment (CDC), registering only 0.5 g. On the other hand, BRS Tracuateua showed greater adaptability, with higher MFR in the control treatment (TC), reaching 1.5 g, and in the nut shell (CDC), with 1.0 g, while in CDA and EDO the values were lower (0.5 g and 0.5 g, respectively). These results corroborate studies such as those by Erlacher et al. (2016), which highlighted the critical influence of substrate composition on root biomass, especially in materials rich in fiber and nutrients, such as açaí seeds.

Figure 3. Fresh mass of the root of the cultivars studied under the different organic treatments.



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The superiority of CDA to BRS Imponente can be attributed to its high porosity and organic matter content, which favor aeration and nutrient availability, essential factors for root development (SILVA et al., 2021). On the other hand, the low efficiency of ODE, observed in both cultivars (averages ≤ 1.5 g), is related to the slow decomposition of sheep manure, as described by Figueiredo et al. (2012). This characteristic was recently reinforced by Lima et al. (2022), who associated the structural rigidity of sheep manure with a reduction in nitrogen and phosphorus release, limiting root absorption. In addition, BRS Tracuateua showed greater resilience in less nutritious substrates, such as TC and CDC, possibly due to genetic mechanisms of tolerance to nutritional stresses, as described in studies on genetic variability in cowpea (OLIVEIRA et al., 2023).

The results show that the selection of substrates should consider the specific requirements of each cultivar. While BRS Imponente requires substrates rich in organic matter of rapid availability, such as CDA, BRS Tracuateua adapts better to suboptimal conditions, reinforcing the importance of personalized management in organic agriculture.

CONCLUSION

The results showed significant differences in the performance of cowpea cultivars in response to organic substrates. The cultivar BRS Imponente showed higher production of green mass and fresh root mass when submitted to açaí seed, followed by control treatment and sheep manure, with intermediate results. However, its worst performance occurred with the nut shell, registering the lowest biomass production.

On the other hand, the cultivar BRS Tracuateua showed greater adaptability, with satisfactory production of green mass and fresh mass of the root in the control treatment and nut shell, although it also responded positively to the açaí pit. Sheep manure was the least effective treatment for both cultivars, resulting in lower root fresh mass, possibly due to the slow release of nutrients.

The açaí seed stood out as the most efficient substrate for BRS Imponente, while BRS Tracuateua showed greater versatility, adapting better to less nutritious substrates. Sheep manure was not suitable for the cultivation of either cultivar.

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