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Production and composition of litter from *umbu* tree genotypes

Abstract – The objective of this work was to evaluate the litter yield and the accumulated nutrient concentrations and amounts in the litter of *umbu* tree genotypes from different origins. The experiment was carried out in a completely randomized design with 14 treatments, during the 2020-2021 season, using 13-year-old trees at the time. The genotypes BGU-44, BGU-45, BGU-47, BRS-48, BGU-50, BGU-75, BRS-68, EPAMIG-03, EPAMIG-04, EPAMIG-05, EPAMIG-06, EPAMIG-07, EPAMIG-09, and EPAMIG-13 were evaluated, with three replicates, each one composed of one plant per plot. Yields and accumulated nutrient concentrations and amounts in the litter varied between genotypes. The decreasing order of macronutrient concentrations in the litter was Ca>N>Mg>K>S>P, and of micronutrients and Na was Fe>B>Mn>Na>Zn>Cu. The accumulated amounts of nutrients are more associated with the litter yield of the genotypes than with nutrient concentrations, since the concentrations varied little. The genotypes BGU-61, EPAMIG-07 and EPAMIG-06 express the highest litter yield and the highest accumulated nutrient amounts, while EPAMIG-05, BGU-75, BGU-44, BGU-50, and BGU-45 show the lowest accumulated nutrient amounts.

Index terms: *Spondias tuberosa*, acessions, fertilization, nutrient cycling.

Produção e composição de serrapilheira de genótipos de umbuzeiro

Resumo – O objetivo deste trabalho foi avaliar a produtividade, os teores e as quantidades acumuladas de nutrientes em serrapilheira de genótipos de umbuzeiro de diferentes origens. O experimento foi realizado em delineamento inteiramente ao acaso com 14 tratamentos, durante a safra 2020-2021, tendo-se utilizado plantas de 13 anos à época. Foram avaliados os genótipos BGU-44, BGU-45, BGU-47, BRS-48, BGU-50, BGU-75, BRS-68, EPAMIG-03, EPAMIG-04, EPAMIG-05, EPAMIG-06, EPAMIG-07, EPAMIG-09 e EPAMIG-13, com três repetições compostas de uma planta por parcela. As produtividades, teores e quantidades acumuladas de nutrientes da serrapilheira variaram entre os genótipos. A ordem decrescente da concentração de macronutrientes foi Ca>N>Mg>K>S>P, e a de micronutrientes foi Na, Fe>B>Mn>Na>Zn>Cu. As quantidades acumuladas de nutrientes estão mais associadas às produtividades de serrapilheira dos genótipos do que à concentração de nutrientes, já que as concentrações variaram pouco. Os genótipos BGU-61, EPAMIG-07 e EPAMIG-06 expressam maiores produtividades de serrapilheira e quantidades acumuladas de nutrientes, enquanto EPAMIG-05, BGU-75, BGU-44, BGU-50 e BGU-45, menores.

Termos para indexação: *Spondias tuberosa*, acessos, adubação, ciclagem de nutrientes.

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Introduction

Umbu (*Spondias tuberosa* Arruda) is a fruit tree endemic to the Caatinga biome in Northeastern Brazil, which is tolerant to drought because of its morphophysiological adaptations that include water and nutrient-storing tubers, osmotic adjustment, leaves with high stomatal resistance, senescence, and leaf abscission during the dry season (Lima Filho & Aidar, 2016). These traits contribute to increase the water use efficiency (Santos et al., 2021b; Donato et al., 2022a) and enable the species to be cultivated under rainfed conditions. These facts constitute an important "technology" for the plants coexistence the semiarid conditions because of the scarcity of water resources that characterizes the region (Sudene, 2017). The water-limiting conditions can be worsened also by climate variability and the growing conflict among the multiple uses of water.

The exploitation of *umbu* tree has been more focused on extrativism aiming at selling its fruit for fresh consumption in urban centers. Recently, the participation of processed *umbu* products has increased through initiatives of associations or cooperatives of fruit collectors and/or family farmers (Fruto…, 2019; Boletim…, 2023).

However, in the last two decades, commercial orchards were established with *umbu* tree genotypes bearing large fruit (between 50 and 75 g) and giant ones (over 75 g) (Donato et al., 2024), which have been prospected and selected by research institutions such as Embrapa and Epamig (Donato et al., 2019b). These crops were spread further across Bahia state and the north of Minas Gerais state, thus requiring the development of crop management technologies (Donato et al., 2019c) and fertilization programs (Donato et al., 2022b).

Particularly important for *umbu* trees is the nutrient cycling – such as the biochemistry between leaves, tubers, flowers, and fruit, as well as the geochemistry of washed nutrients from leaves to the ground, and the biogeochemistry of decomposing litter to the roots (Donato et al., 2019a, 2022b). In the litter, the accumulated amount of nutrients that may return to the plant through cycling may vary with the accession, mostly depending on the nutrient content and canopy size (Santos et al., 2020; Donato et al., 2022b; Donato & Neves, 2023).

The litter is responsible for retaining large quantities of nutrients, constituting an important way for mineral elements from vegetation to return to the soil, and the composition and quantity of these elements can vary depending on the time of the year, collection location, temperature, humidity, initial quality of the forming material, and soil organisms (Godinho et al., 2014). Elements that are part of the plant structure, such as Ca, are found more in the litter than mobile elements, such as K, which is not part of molecules and is easily washed away (Godinho et al., 2014). Even the management under the canopy, without weeding, favors the accumulation of organic residues on the soil surface, promoting the soil fertility and the productivity of plants (Morais et al., 2020). Cycling plays an even more crucial role in times of high input prices, particularly fertilizers, since nutrient cycling can reduce the dependence on external inputs, which is essential to the environmental and financial sustainability of crops commonly grown by family farmers.

In a study on the rate of retranslocation or biochemical cycling of nutrients between new and senescent leaves of *umbu* trees, Santos et al. (2020) found differences in rates between genotypes and cycles, and the following decreasing order of retranslocation: K>P>N>Mg. However, there is a demand for data on the quantity produced, nutrient levels accumulated in litter, and whether there are differences between *umbu* genotypes. This is important to estimate the theoretical biogeochemical cycling of nutrients and their possible contribution to the nutritional economy.

The objective of this work was to evaluate the litter yield and accumulated nutrient concentrations and amounts in the litter of *umbu* tree genotypes.

Materials and Methods

The experiment was carried out at the *umbu* tree genotype collection of Instituto Federal de Educação, Ciência e Tecnologia Baiano (IF Baiano), campus Guanambi, in the state of Bahia, Brazil (14º17'32"S, 42º41'34"W, at 547 m altitude). According to the Köppen-Geiger's classification, the climate is hot and dry semiarid, with a well-defined dry season in the winter and a rainy period between October and March. The main meteorological data from the experiment site are shown in figure 1. The average annual precipitation is 671.5 mm, and the average annual temperature is 26ºC, considering the last 41 years, according to data recorded at the Ceraíma meteorological station Codevasf (1982–2006) and