IMPACTO CIENTÍFICO EDITORA

DIAGNOSTIC ANALYSIS OF WATER SUPPLEMENTATION IN BANANA PRODUCTION (Musa spp.) BY MICROSPRAYING

ANÁLISE DIAGNÓSTICA DE SUPLEMENTAÇÃO HÍDRICA NA PRODUÇÃO DE BANANEIRA (Musa spp.) POR MICROASPERSÃO

ANÁLISIS DIAGNÓSTICO DE LA SUPLEMENTACIÓN HÍDRICA EN LA PRODUCCIÓN DE PLÁTANO (Musa spp.) MEDIANTE MICROASPERSIÓN

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ABSTRACT

The objective of this study was to perform a diagnostic analysis of water supplementation for banana crops (*Musa spp*.) planted at the Araguaia Agroecological Center (CEAGRO/IFPA). The evaluated area, covering 0.4 ha, had a spacing of 3 x 3 m and 476 adult plants, distributed across 14 rows. Based on the diagnosis of water requirements and available infrastructure, a micro-sprinkler irrigation system was designed using MF2 emitters (Amanco), with a flow rate of 76 L/h and a radius of 4.5 m. The design included division into two independent sectors and the installation of 119 emitters, seeking greater efficiency and reduced water losses. Irrigation management will be based on meteorological data to calculate ETO and ETC. The adoption of the system aims to boost productivity, ensure water regularity, and meet the crop's demand at different phenological stages.

Keywords: Sizing. Irrigation Management. Productivity.

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RESUMO

O presente estudo teve como objetivo realizar a análise diagnóstica da suplementação hídrica para a cultura da bananeira (*Musa spp*.) implantada no Centro Agroecológico do Araguaia (CEAGRO/IFPA). A área avaliada, com 0,4 ha, apresentava espaçamento de 3 x 3 m e 476 plantas adultas, distribuídas em 14 linhas. A partir do diagnóstico da necessidade hídrica e da infraestrutura disponível, projetou-se um sistema de irrigação por microaspersão utilizando emissores MF2 (Amanco), com vazão de 76 L/h e raio de 4,5 m. O dimensionamento incluiu divisão em dois setores independentes e instalação de 119 emissores, buscando maior eficiência e redução de perdas de água. O manejo de irrigação será realizado com base em dados meteorológicos para cálculo do ETO e ETC. A adoção do sistema visa potencializar a produtividade, garantir regularidade hídrica e atender a demanda da cultura em diferentes estádios fenológicos.

Palavras-chave: Dimensionamento. Manejo de Irrigação. Produtividade.

RESUMEN

El presente estudio tuvo como objetivo realizar el análisis diagnóstico de la suplementación hídrica para el cultivo del plátano (Musa spp.) implantado en el Centro Agroecológico de Araguaia (CEAGRO/IFPA). El área evaluada, con 0,4 ha, presentaba un espaciamiento de 3 x 3 m y 476 plantas adultas, distribuidas en 14 hileras. A partir del diagnóstico de las necesidades hídricas y de la infraestructura disponible, se diseñó un sistema de riego por microaspersión utilizando emisores MF2 (Amanco), con un caudal de 76 L/h y un radio de 4,5 m. El dimensionamiento incluyó la división en dos sectores independientes y la instalación de 119 emisores, con el fin de lograr una mayor eficiencia y reducir las pérdidas de agua. El manejo del riego se realizará sobre la base de datos meteorológicos para el cálculo del ETO y el ETC. La adopción del sistema tiene como objetivo potenciar la productividad, garantizar la regularidad hídrica y satisfacer la demanda del cultivo en diferentes etapas fenológicas.

Palabras clave: Dimensionamiento. Manejo de Riego. Productividad.

1 INTRODUCTION

The cultivation of banana (*Musa spp*.) requires high water availability throughout the production cycle, especially in regions subject to prolonged droughts. The central problem lies in the absence of an irrigation system that ensures uniformity in the application of water and avoids losses due to deep percolation, a factor that can compromise root development and reduce the efficiency of water use.

Studies such as Silva *et al*. (2013) point out that, although microsprinkler systems present high uniformity of application, there are still concerns about the spatial distribution of water in the root zones, especially in different flow configurations and arrangements. In drip systems, Silva *et al*. (2009) demonstrated that increasing the number of emitters per plant increases the efficiency of water application by up to 92%, reducing losses due to percolation, drift, evapotranspiration and promoting better root distribution. Coelho *et al*. (2020) showed that micro-sprinkling provides greater root distribution than drip in banana cv. Gorutuba Silver, especially with flow rates between 35 and 70 L h^{-1}.

In addition, Silva *et al*. (2013) used RDT to evaluate the application efficiency in systems with 32 and 60 L/h microsprinklers and obtained efficiency between 80 % and 90 %, depending on the configuration used. Santana Júnior *et al*. (2021), investigated the hydrodynamic processes in the root profile and recommended ideal positioning of moisture sensors between 0.75 m and 0.83 m from the pseudostem for microsprinkling, considering flow rates of 35 to 70 L/h in localized systems. Additionally, Xaviera *et al.* (2020) compared drip and micro-sprinkler systems with soil cover and fertigation in bananas in Northeast Brazil, finding that the combined use of drip and mulch improved chemical fertility and soil microbial activity in two years of cultivation.

In this context, the objectives of the study are to diagnose the water need of banana farming in an experimental area of CEAGRO/IFPA; to design a micro-sprinkler system compatible with the spacing, root depth and available infrastructure; and technically and agronomically justify the choice of the proposed system, considering its effects on productivity, uniformity of application and efficiency in water use. Thus, the delimitation focuses on improving crop performance through localized irrigation.

At the Araguaia Agroecological Center (CEAGRO/IFPA), it is observed that the spacing of 3 m × 3 m and root depth of about 60 cm require efficient irrigation to avoid water stress and ensure stable productivity. Therefore, this work is limited to the diagnostic analysis of the water requirement of the banana crop and to the design of a localized irrigation system, adapted to the physical and climatic conditions of the experimental area of 0.4 ha.

2 METHODOLOGY

The study was conducted at the Araguaia Agroecological Center (CEAGRO), an experimental unit of the Federal Institute of Education, Science and Technology of Pará (IFPA), located in the southeast of the state of Pará. The area for the experiment has 0.4 ha (4,000 m²), with dimensions of 100 m x 40 m (Figure 1), and is used for the cultivation of banana (Musa spp.) at a spacing of 3 m x 3 m (Figure 2). The crop is composed of 476 adult plants, distributed in 14 rows with 34 plants each, organized into two sectors: Sector I, with 224 plants (16 plants per row), and Sector II, with 252 plants (18 plants per row). According to the Brazilian Institute of Geography and Statistics (IBGE), the predominant soil is the dystrophic Red Latosol, with the presence of clay, flat and smooth undulating.

The initial diagnosis considered the depth of the root system of the crop (60 cm), the culture coefficient (Kc) ranging from 0.4 to 1.1, considering Kc in the value of 0.88, according to the phenological stages and the water conditions of the soil and local climate. The survey of water needs was based on reference evapotranspiration (ETO), 10.81 mm/day, followed by crop evapotranspiration (ETC), 9.53 mm/day, obtained by data from the automatic meteorological station of the National Institute of Meteorology (INMET).

2.1 SYSTEM SELECTION AND SIZING

It was decided to implement a micro-sprinkler irrigation system, aiming at high uniformity of application and efficient coverage of the root volume. The selected emitter was the MF2 microsprinkler of the Amanco brand, with a flow rate of 76 L/h, operating pressure of 15 m.c.a and a reach of 4.5 m. Each micro sprinkler will be installed between four plants, positioned on the lateral lines with a spacing of 6 meters. 119 micro sprinklers will be installed to cover the entire cultivated area, with 8 emitters per line in Sector I and 9 emitters per line in Sector II.

To optimize management and reduce load losses and waste, the area was subdivided into two independent sectors. Each sector will have 7 lateral lines (16 mm diameter hoses) spaced 6 meters apart. The lines of Sector I will be 47 meters long and those of Sector II, 53 meters. In all, approximately 700 meters of side hose will be used. The main line, 50 mm in diameter and 80 meters long, will conduct the water pumped from a reservoir (Figure 3) near the composter, using a motor pump already available at CEAGRO.

Connections will be made through registers, initial connectors and end-of-line plugs, allowing individual control by sector. The project foresees the installation of 14 initial connectors with registers and 14 final connectors of 16 mm for sealing.

2.2 IRRIGATION MANAGEMENT

The first irrigation was carried out with sufficient depth to saturate the soil profile, ensuring the initial water balance. Subsequent irrigations were determined by the climatological method, using daily ETO values provided by INMET. Based on the specific Kc of each phenological phase of the banana plant, the necessary depth was calculated for each sector, seeking to meet the water demands of the crop without exceeding the soil retention capacity and avoiding deep percolation.

3 RESULTS AND DISCUSSION

The diagnosis showed that the banana crop, due to its high water requirement and irregular distribution of rainfall in the region, needed water supplementation to ensure continuous production. The designed micro-sprinkler system enables uniform coverage, low operating cost and flexibility in management.

With 119 emitters distributed between two sectors, irrigation will serve the 476 plants in a balanced way, respecting the spacing of 3 x 3 m and the root depth of 60 cm. Division into independent sectors reduces pressure on the main line and facilitates maintenance.

In addition to meeting water demand, the system allows greater control over the applied blade, prevents waterlogging and contributes to the efficiency of water use. Studies cited by Coelho *et al*. (2018) and Souza *et al.* (2020) point out that micro-sprinkling on bananas can increase productivity by up to 30%, especially in soils with low water retention.

4 FINAL CONSIDERATIONS

The implementation of the micro-sprinkler irrigation system in the banana cultivation of CEAGRO/IFPA was presented as a viable and efficient technical solution to meet the water demand of the crop. The dimensioning based on the local diagnosis allowed to optimize resources, reduce water losses and enhance production, ensuring the regularity of the water supply in all phenological phases of the plant and the adoption of management via ETO and Kc provided greater precision in irrigation, contributing to the sustainability and productive efficiency of the system.

REFERENCES

Coelho, E. F., & et al. (2018). Manejo de irrigação em fruticultura tropical (2nd ed.). Embrapa.

Instituto Nacional de Meteorologia. (2025). Notícias: Balanço hídrico. Portal INMET. https://portal.inmet.gov.br/

Instituto Brasileiro de Geografia e Estatística. (2025). Pedologia por estado (Acre; Amapá; Amazonas; Maranhão; Mato Grosso; Pará; Rondônia; Roraima; Tocantins). https://www.ibge.gov.br/geociencias/cartas-e-mapas/mapas-estaduais/15828-pedologia-do-estado-de-ro-rr-to-ac-am-ap-ma-mt-pa-e-rs.html

Santana Júnior, E. B., & et al. (2021). Management of trickle irrigation for banana: Hydrodynamic processes and sensor placement at the root zone. Revista Brasileira de Engenharia Agrícola e Ambiental, 25(8), 556–564. https://doi.org/10.1590/1807-1929/agriambi.v25n8p556-564

Silva, A. J. P., & et al. (2013). Avaliação de sistemas de irrigação localizada por microaspersão e gotejamento em bananeira sob condições semiáridas. Revista Brasileira de Engenharia Agrícola e Ambiental, 17(8), 850–856. https://doi.org/10.1590/S1415-43662013000800008

Silva, J. R., & et al. (2009). Eficiência de aplicação de água por gotejamento em bananeira sob diferentes manejos. Revista Brasileira de Fruticultura, 31(3), 790–798. https://doi.org/10.1590/S0100-29452009000300033

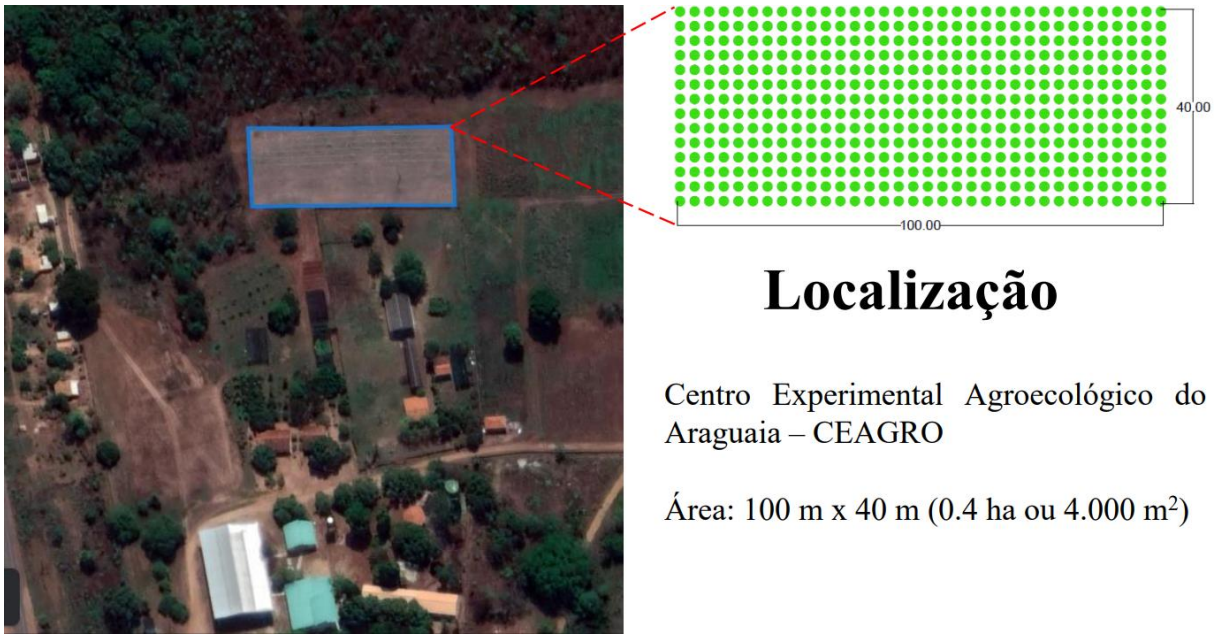
Souza, C. F., & et al. (2020). Sistemas de irrigação para a cultura da bananeira: Recomendações técnicas. Revista Brasileira de Fruticultura, 42, e-102. https://doi.org/10.1590/0100-29452020817

Xaviera, S. S., & et al. (2020). Soil fertility and microbial activity in banana under drip and microsprinkler irrigation systems with mulching. Communications in Soil Science and Plant Analysis, 51(19), 2515–2527. https://doi.org/10.1080/00103624.2020.1845359

ATTACHMENTS

Figure 1

Satellite image of the Araguaia Agroecological Center (CEAGRO), an experimental unit of the Federal Institute of Education, Science and Technology of Pará (IFPA) and sketch of the cultivated area



Source: Google Earth; Author, 2025

Figure 2

Banana culture present at the Araguaia Agroecological Center (CEAGRO)

Source: Author, 2025

Figure 3

Reservoir that will pump water to meet the water demands of the irrigation project

Source: Author, 2025