

EVAPOTRANSPIRATION ESTIMATE FOR THE MUNICIPALITIES OF ITAMARAJÚ AND SENHOR DO BOMFIM – BAHIA

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ABSTRACT: Theoretical background on evapotranspiration is of importance for a better irrigation management in the agricultural crops through the existent water needs. In this aspect, the present work has the objective of comparing two methods for the reference evapotranspiration (ET_o), Priestley-Taylor and Blaney & Criddle, in the dry and humid times of Itamarajú and Senhor do Bomfim, located in the state of Bahia. The standard error of the estimation (SSE) and the standard error of the adjusted estimate (SSE_a), coefficients of determination (R²) and standard error of the adjusted estimate by origin (SEE_{ao}) were evaluated. The data were collected on the INMET website through meteorological stations of the respective cities. The Priestley-Taylor method obtained the best results for the two cities and also for the periods (dry and humid) studied, and can therefore be used as reference for estimating reference evapotranspiration and irrigation management techniques.

KEYWORDS: irrigation management, Blaney e Criddle, Penman-Montheith

ESTIMATIVA DA EVAPOTRANSPIRAÇÃO PARA OS MUNICÍPIOS DE ITAMARAJÚ E SENHOR DO BOMFIM – BAHIA

RESUMO: Embasamento teórico sobre a evapotranspiração é de importância para um melhor manejo da irrigação nas culturas agrícolas através das necessidades hídricas ali existentes. Nesse aspecto, o presente trabalho tem como objetivo comparar dois métodos para a evapotranspiração de referência (ET_o), o de Priestley-Taylor e o Blaney e Criddle, nas épocas

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secas e úmidas das cidades de Itamarajú e Senhor do Bomfim, situadas no estado da Bahia. Avaliou-se erro padrão da estimativa (EPE) e o erro padrão da estimativa ajustada (EPEa), coeficientes de determinação (R^2) e erro-padrão da estimativa ajustada por origem (EPEao). Os dados foram coletados no site do INMET por meio de estações meteorológicas das respectivas cidades. O método de Priestley-Taylor obteve os melhores resultados para as duas cidades e para as épocas (seca e úmida) estudadas, podendo assim, ser utilizada como referência para estimativa da evapotranspiração de referência e nas técnicas do manejo da irrigação.

PALAVRAS-CHAVE: manejo da irrigação, Blaney e Criddle, Penman-Montheith

INTRODUCTION

The use of water for the farm is a limiting factor in productive potential. The use of reference evapotranspiration (ET_o) data in production is indispensable because it consists of an instrument to support the cultivation of plants, mainly due to the great climatic variations that exist in the country. The demand for meteorological data observation is fundamental, and, therefore, studies of mathematical models, is a tool for the monitoring and management of irrigation.

The use of methodologies for evaluating ET_o and its adaptation according to the region in question became indispensable. Given that the Penman-Montheith method (FAO-FAO 56) is recommended by the Food and Agriculture Organization of the United Nations (FAO), because the results characterize this method by presenting safer estimates when compared to others (Allen et al., 1998). However, in some regions this model may not be significant. Therefore, the objective of this present work is to compare the method suggested by FAO, Penman-Montheith, such as the Blaney and Criddle and Priestley-Taylor models in the cities of Itamarajú and Senhor do Bomfim Bahia, in 2018.

MATERIAL AND METHODS

The work was carried out in two cities of the state of Bahia. Itamarajú, coordinates 17° 02' 21" S and 39° 31' 52" W with an average altitude of 112m. According to the classification of Köppen, the climate is type Am, tropical rainy forest, with one to three dry months, having

an average annual rainfall of 1136 mm. The economy of the city is based on agriculture, with emphasis on fruit, cocoa and coffee plantations. The city of Senhor do Bomfim, located in the north of the state, with coordinates of 40,1808 10 ° 27 '57 "S and 40 ° 10' 51" w. The city of Senhor do Bonfim, located in the north of the state, with coordinates of 40,1808 10 ° 27 '57 "S and 40 ° 10' 51" w.

The climate is type Aw, tropical subhumid with summer rains, dry period well defined in the winter and predominant vegetation of cerrado, according to the classification of Köppen. Agricultural production is mostly composed of pineapple, sweet potato, sugar cane, bean, castor bean and cassava. The data on the climatic variables were obtained through an automatic INMET station located in each of the municipalities for the year 2018. Calculations of ETo estimation were performed using Penman-Montheith methods (Allen et al., 1998) (1), Blaney & Criddle (Allen & Pruitt, 1986) and Priestley-Taylor (1972).

$$ET_o = \frac{0.408 \Delta(R_n - G) + \gamma \frac{900}{T + 273} u_2 (e_s - e_d)}{\Delta + \gamma(1 + 0.34u_2)} \quad (1)$$

wherein:

ET_o - reference evapotranspiration (mm.d⁻¹); R_n- net radiation at the surface (MJ.m⁻².d⁻¹); G - soil heat flux (MJ.m⁻².d⁻¹); T - air temperature (°C); u₂ - wind speed at 2.0 m height (m s⁻¹); (e_s-e_d) - vapor pressure deficit (kPa); Δ - the slope of the curve saturation vapor pressure (kPa. C⁻¹); γ - psychrometric constant (kPa. C⁻¹).

In order to compare the ETo values between Penman-Montheith and the other methods, the criteria proposed by Jensen et al. (1990), which are the standard error of the estimate (SEE) (2) and the standard error of the adjusted estimate (SEEA) (3), coefficients of determination (R²) and standard error of origin-adjusted estimation (SEEA_o) evaluation methods,

$$SEE = \left(\frac{\sum (Y_i - Y_m)^2}{n - 1} \right)^{0.5} \quad (2)$$

$$SEEA = \left(\frac{\sum (Y_{ic} - Y_m)^2}{n - 1} \right)^{0.5} \quad (3)$$

wherein:

Y_i - evapotranspiration estimated by the method (mm.d^{-1}); Y_m - evapotranspiration estimated by the standard method (mm.d^{-1}); Y_{ic} - estimate using evapotranspiration, adjusted by coefficients of linear regression (mm.d^{-1}); and n- total number of observations.

RESULTS AND DISCUSSION

The Priestley-Taylor method in the dry period obtained the best results for all analyzed variables (Table 2). However, Lucena et al. (2016) verified that in the city of Bom Jesus-PI, for the wet period the method in question also obtained the best results for the analyzed variables. However, Lucena et al. (2016) verified that in the city of Bom Jesus-PI, for the wet period the method in question also obtained the best results for the analyzed variables.

Table 1. Coefficient of determination (R^2), standard error of estimate (SSE) and standard error of the adjusted estimate (SEEA), during the dry period in the two study sites.

Penman-Montheith	Itamarajú Períod Dry		
	R^2	SEE	SEEA
Blaney e Criddle	0.6141	2.71	2.7
Priestley-Taylor	0.9999	0.65	0.65
Penman-Montheith	Senhor do Bonfim - Períod Dry		
	R^2	SEE	SEEA
Blaney e Criddle	0.172	1.75	1.1
Priestley-Taylor	0.9978	0.33	0.33

Table 2. Coefficient of determination (R^2), standard error of estimate (SSE) and standard error of the adjusted estimate (SEEA), during the wet period in the two study sites.

Penman-Montheith	Itamarajú - Períod Humid		
	R^2	SEE	SEEA
Blaney e Criddle	0.5666	2.64	2.56
Priestley-Taylor	0.9999	0.65	0.65
Penman-Montheith	Senhor do Bonfim - Períod Humid		
	R^2	SEE	SEEA
Blaney e Criddle	0.5258	3.03	2.96
Priestley-Taylor	0.9988	0.48	0.48

Figures 1 and 2 show that the linear regression for the Priestley-Taylor method showed an overestimation of the data of the respective cities in both periods analyzed. The data revealed corroborate Nova & Pereira (2006), who evaluated both methods, found an overestimation for the data of the city of Piracicaba-SP. These results, however, can be used for and estimation of the cities analyzed using ETo.

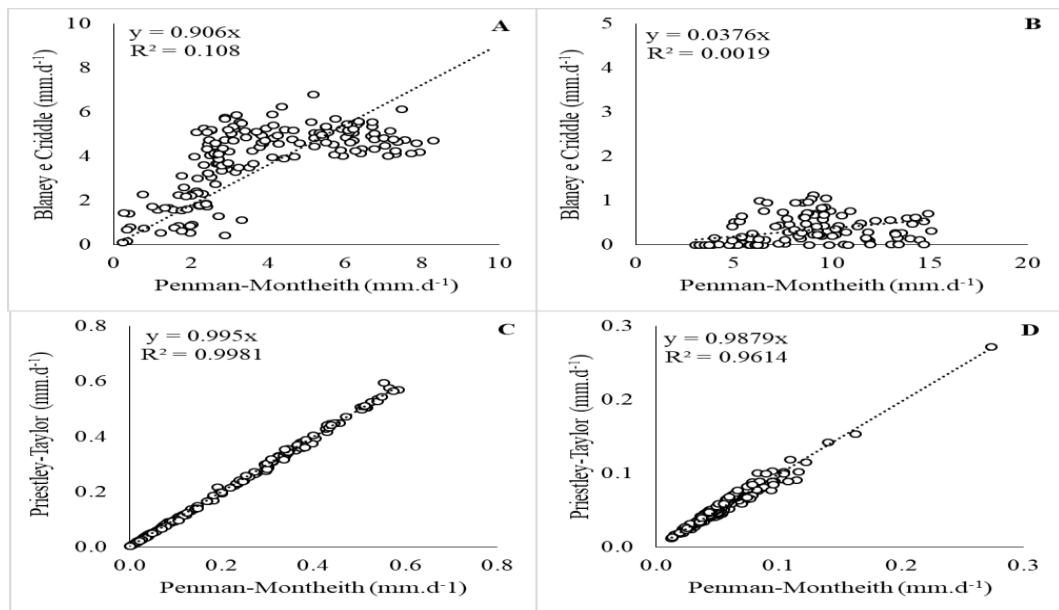


Figure 1. Linear regression between daily values of reference evapotranspiration (ETo) for the dry period, forced by the origin, estimated by the Penman-Monteith method in relation to Blaney and Criddle and Priestley-Taylor for Itamarajú-BA location (A and C) and Senhor do Bonfim-BA (B and D).

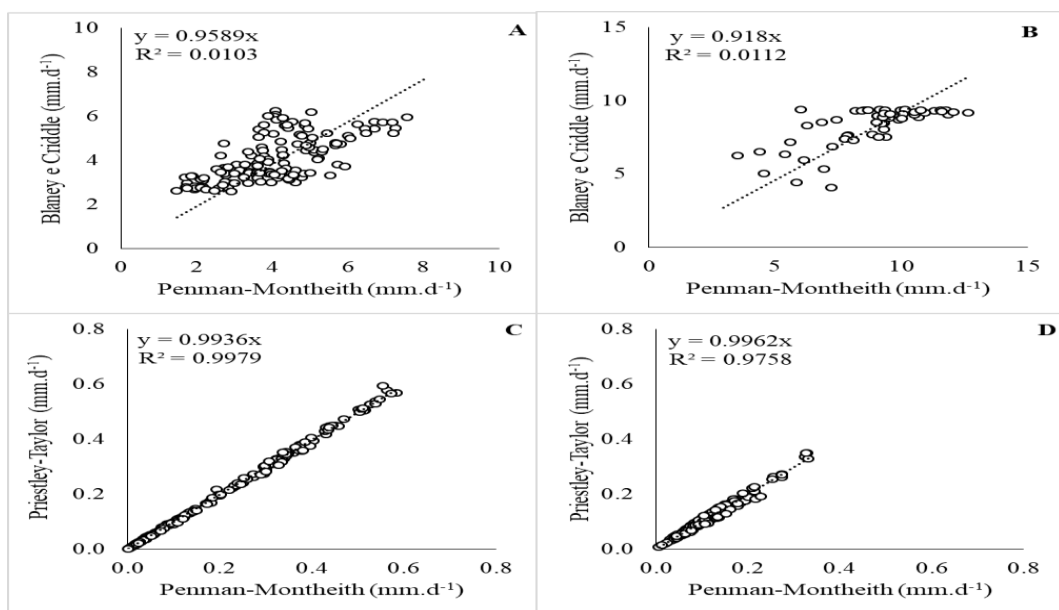


Figure 2. Linear regression between daily values of the reference evapotranspiration (ET_o) for the wet period, forced by the origin, estimated by the Penman-Monteith method in relation to Blaney and Criddle and Priestley-Taylor for Itamarajú-BA location (A and C) and Senhor do Bonfim-BA (B and D).

CONCLUSIONS

The Priestley-Taylor method revealed the best result in the cities of Itamaraju and Senhor do Bomfim for the dry and humid periods. In this sense, the method can be indicated as a reference for irrigation management in the respective cities.

ACKNOWLEDGEMENTS

To CNPq, FAPESB, CAPES and UESB.

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