ACCUMULATED INFILTRATION AND SPEED OF INFILTRATION IN SANDY LOAM SOIL WITH AND WITHOUT VEGETABLE COVERAGE

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ABSTRACT: Infiltration is a process that occurs naturally in the hydrological cycle, in this process water that arrives through the precipitation or irrigation blade penetrates into the subsurface layers of the soil. With the knowledge of infiltration velocity and its relationship with soil properties, it is possible to carry out the correct irrigation management. Thus, the objective of this work was to determine the accumulated infiltration and infiltration velocity in sandy loam soil with vegetation cover and without cover, by the double ring infiltrameter method. The study was developed in the rural area of the city of Junqueiro-Al. The concentric rings used had different diameters, the internal one had a diameter of 25 cm, while the external one had a diameter of 50cm. The readings were carried out at 2, 5, 10 and 30 minutes, totaling 280 minutes. The results of accumulated infiltration and velocity of infiltration are similar in both areas, where the two variables present opposite behaviors, in which the vegetated area presented a VIB of 29 mm / h and infiltration of 13 cm, and the non vegetated 26 mm / he Infiltration of 12cm. Based on the values found the soil is classified with a high VIB.

KEYWORDS: Concentric rings, irrigation, basic infiltration velocity.

INFILTRAÇÃO ACUMULADA E VELOCIDADE DE INFILTRAÇÃO EM SOLO FRANCO-ARENOSO COM E SEM COBERTURA VEGETAL

RESUMO: A infiltração é um processo que ocorre naturalmente no ciclo hidrológico, neste processo água que chega através da precipitação ou lâmina de irrigação penetra para as camadas subsuperfíciais do solo. Com o conhecimento da velocidade de infiltração e das suas relações com as propriedades do solo é possível realizar-se o manejo correto da irrigação. Assim o objetivo do trabalho foi determinar a infiltração acumulada e a velocidade de infiltração em

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solo franco-arenoso com cobertura vegetal e sem cobertura, pelo método do infiltrômetro de duplo anel. O estudo foi desenvolvido na zona rural da cidade de Junqueiro- Al. Os anéis concêntricos utilizados apresentavam diâmetros diferentes, o interno possuía diâmetro de 25cm, enquanto o externo tinha diâmetro 50cm. Realizaram-se leituras nos tempos de 2, 5, 10 e 30 minutos, totalizando 280 minutos. Os resultados de infiltração acumulada e velocidade de infiltração se mostram semelhantes nas duas áreas, onde as duas variáveis apresentam comportamentos opostos, em que a área vegetada apresentou uma VIB de 29 mm/h e infiltração de 13 cm, e a não vegetada de 26mm/h e infiltração de 12cm. Baseado nos valores encontrados o solo é classificado com uma VIB alta.

PALAVRAS-CHAVE: Anéis concêntricos, irrigação, velocidade de infiltração básica.

INTRODUCTION

Infiltration is a process commonly performed by water in the hydrological cycle, it is the entry of water into the soil surface, either by precipitation or via irrigation plates. The velocity of infiltration Basic (VIB) of water in a soil evidences the time and the amount of water that soil supports, besides demonstrating the water balance in the zone of the roots and the superficial defluvium.

Irrigation aims to provide enough water to raise the soil moisture, and always maintain it in the field capacity a effective depth of the root system of the implanted crop. So, the study of the phenomenon linked to the movement of water in the soil is essential.

With knowledge of infiltration speed and its relationship with soil properties is possible to correct irrigation management, thus reducing erosion processes, as well as stimulating the recharge of underground aquifers and the good development of the plant.

The VIB has great importance in the hydrological cycle, because it represents the maximum intensity that the soil in given condition and time, can absorb rainwater or irrigation applied at a certain rate. (SALES et al, 1999).

As it is a parameter to evaluate the soil physical quality, it is understood that the velocity of infiltration depends on many factors, such as porosity, soil density, initial soil water content, texture and degree of aggregation of soil in soil particles, vegetation cover and soil moisture.

Sandy soil, Sandy Loam Soil are usually found in the Northeast region of Brazil and have a very high VIB characteristic.

Meanwhile, the vegetated cover influences the amount of organic matter present in the soil, as well as the evaporative soil rate.

Therefore, since water in the Northeast is a limiting factor, studies observing the behavior of infiltration velocity in sandy soils with and without cover in order to promote the rational use of available water through proper irrigation management, has relevant important.

Thus, the objective of this work was to determine the accumulated infiltration and infiltration velocity in sandy loam soil with vegetation cover and without cover, by the double ring infiltrameter method.

MATERIAL AND METHODS

The study was developed in the rural area of the city of Junqueiro-Al, with cartesian coordinates 9° 54' 14" south latitude, 36° 28' 0" west longitude and altitude of 214m.

This region it is found in small region of São Miguel dos Campos, belonging to mesoregion of east alagoano, which clime is classified like AW tropical bwith winter dried and summer rainy, by the criterion the Koppen.

The study was realizing in distinct areas. The first area was a cultivation the cassava (*Manihot esculenta*) associated with cultivation the bean (*Phaseolus vulgaris*), the second n area was without vegetation, but were for harrowing recently.

Speed of infiltration rate was determined for methodology of BERNARDO et al (2006), for method the concentric rings used had different diameters, the inner one had a diameter of 25 cm, while the external one had a diameter of 50cm.

Was installed the concentric rings vertical in soil burying 15cm.The external ring has objective create one fisic barrier, it´s don´t let a dispersal lateral of water infiltrated the inner ring because exist the capillarity effect. The inner ring make for water will be infiltrated just vertically, reduceding the overvalue rate water infiltration in soil.

Firstly the rings were installed in the vegetated area, after installed in area without vegetation. After the rings were installed, the inner ring was coated with a plastic and water was added simultaneously to the two rings. The plastic was removed and the vertical infiltration of the inner ring was followed by a ruler in cm at intervals of two minutes. Observed in a stopwatch, this time was increased to the detriment of the infiltration time of the water volume.

The readings started with the time of 2 min with 15 repetitions, increasing to 5 min with 10 repetitions and for 10 min and 30 min with 5 repetitions each, totaling 280 min from the zero time for performing this experiment. The increase in time variation was to the detriment of the

time reached for infiltration of the volume of water in the soil, while the rate of constant infiltration was according to the value of the water charge in the inner cylinder being repeated by at least four times.

The same process of installation of the rings and conduction of the experiment was performed in the non-vegetated area, it is worth noting that it was graded. The readings for this area also started in the time of 2 min, 5 min, 10 min and 30 min, with repetitions until reaching the rate of constant infiltration, with a total time of 280 min.

With the data collected in the field it was possible to determine the accumulated infiltration (I) and velocity of infiltration rate (VI), for both situations. At first the accumulated infiltration (I) was determined. The mean velocity of infiltration rate (VIm) and the infiltration accumulated in a period of time, divided by the time itself (equation 1).

$$VIm = (I/T) * 60 \quad (1)$$

At where:

I = accumulated infiltration (cm);

T = infiltration time (min);

The accumulated velocity of infiltration rate (VIa) is given by the variation of infiltration (ΔI) in a period of time (ΔT), divided by time (equation 2).

$$VIa = (\Delta I/\Delta T) * 60 \quad (2)$$

In order to describe the accumulated infiltration of the water in the soil the equation 3 is used:

$$I = a\ T^{n} \quad (3)$$

At where:

I = accumulated infiltration (cm);

a = constant dependent on the soil, dimensionless;

T = infiltration time (min);

N = soil-dependent constant, ranging from 0 to 1.

The velocity of infiltration rate (VI) is determined by the derivative of accumulated infiltration, in relation to time (equation 4):

$$VI = n * a\ T^{(n-1)} \quad (4)$$

By doing a * n = k, we have equation 5:

$$SI = 60 * k\ T^{(n-1)} \quad (5)$$

At where:

SI = rate of instantaneous infiltration;

k = infiltration capacity in the first minute;

T = time to reach the rate of instantaneous infiltration.

N = slope of the line.

Applying logarithm in equation 3, we have:

$$\text{Log } I = \text{Log } a + n \times \text{Log } T$$

Which corresponds to the equation of the type y = a + bx, where:

Y = log I

A = log a

B = n

X = log T

For values in the linear equation, the regression method, described by equation 6:

$$N = b = [(\Sigma (x * y) - ((\Sigma x * \Sigma y) / N)) / (\Sigma X^2 - (\Sigma x)^2) / N)] \quad (6)$$

To obtain the time of the basic infiltration velocity, the equation 7 was used:

$$Tvib = [(- 0.001) / (c * n (n-1))^{(1 / (n-2))}] \quad (7)$$

RESULTS AND DISCUSSION

The graphs of accumulated infiltration (I) and velocity of infiltration rate (VI) showed inverse relation (graphics 1 and 2) It is observed that the infiltration tends to increase throughout the test, while the rate of infiltration decreases, approaching a constant value. When the velocity of infiltration remains constant at a given time, we call it the basic infiltration velocity (VIB), essential when the soil is to be managed, mainly in terms of irrigation.

For the vegetated area (graphic 2), it initially observed an speed of infiltration rate of 150cm / h and over time this speed decreased to 2.91cm/h, approaching a constant value, thus the VIB for this situation was 29mm/h. For the non-vegetated area (graphic 1), was found a maximum infiltration speed of 153cm/h, decreasing to 2.61cm/h, reaching a VIB of 26mm/h.

BERNARDO et al. (2006) cites that it is evident that the rate of infiltration tends to decrease and remain constant over time.

In contrast to the one found in this work, SANTOS et al., (2013) working with Argissolo found a VIB of 2mm/h, as well as GONDIM et al. (2010) found a VIB of 10.9mm/h in sandy

soil. This shows that the VIB values are quite contrasting due to the different physical and morphological characteristics associated to the structure of the soil horizons.

According to BERNARDO et al., (2006) the soil, according to its velocity infiltration basic, is classified as: >30mm/h (very high VIB); Of 15-30mm/h (high VIB); 5-15mm/h (mean VIB) and 5mm/h (low VIB). From the VIB value found, the soil for both situations is classified with a high VIB.

BERNARDO et al., (2006), also establishes the textural classification of soils by VIB. Thus, the soils can be: sandy when the VIB is 25-250mm/h; French-sandy 13-76mm/ h; Sand-clay-loam 5-20mm/h and clay loam 2.5-15mm/h. Confirming the information present in the physical analysis, the soil under study according to the value of VIB is of sandy-loam texture.

CONCLUSION

The method of infiltration for rings concentric in vegetated area as well as without vegetated show similar deportment for speed of infiltration rate and the accumulated infiltrated, because the vegetated area was a VIB of 29mm/h and without vegetated area was 26mm/h.

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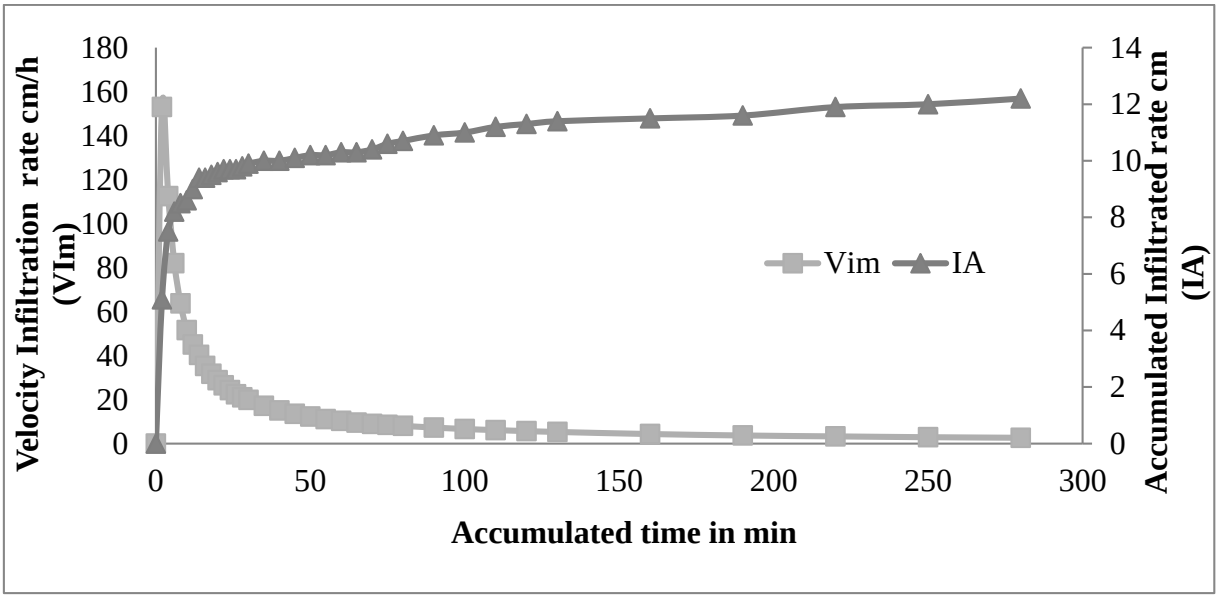
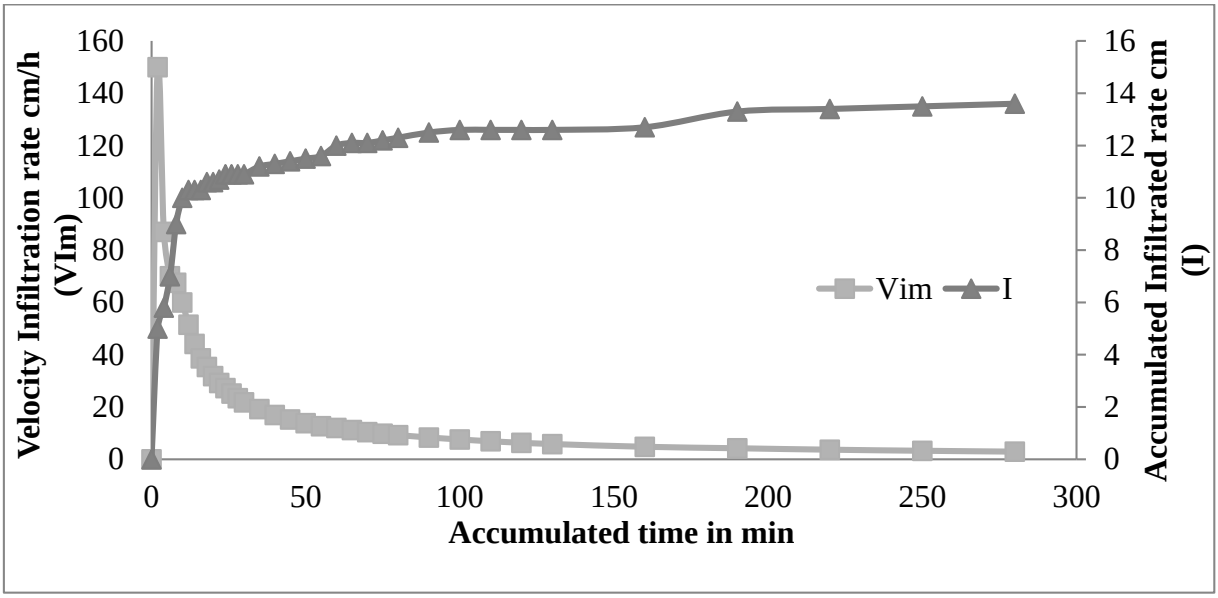


Graphic 1. Speed vs Accumulated Infiltration in soil without vegetation cover**.**



Graphic 2. Speed vs Infiltration in soil with vegetation cover.