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Comparative evaluation of Percolation rates in conventionally puddled paddy fields of sangareddy, Telangana state

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ABSTRACT: *Percolation in paddy fields is one of the important parameter which contributes to water loss. Almost 75% of water loss in paddy fields is through percolation. Study was conducted to measure and compare the percolation rates of conventionally puddled paddy fields. Study was conducted in six conventionally puddled fields of sangareddy, Telangana state of India. Rapid response percolation meter was fabricated and used to measure percolation rates. The percolation rates observed in 1, 2, 3 fields are 35.596, 35.596, 37.008 and 4, 5, 6 are 14.803, 20.794 and 16.918 mm/day respectively. The fields 1, 2 and 3 are having heavy clay soils and 4,5 and 6 fields are having clay loam soils. It is observed that the obtained percolation rates are notably distinct from ideal paddy field percolation rates.*

Keywords: *Puddled fields, water loss, Percolation rates, Rapid response percolation meter.*

INTRODUCTION

Percolation refers to the vertical movement of water beyond the root zone to the water table. It is an essential parameter to calculate water requirement for paddy fields (Behera *et al.*, 2009). Measurement of water balance including percolation is necessary for flooded rice fields. Approximately 75% of water applied to rice crop is lost through deep percolation during submergence of field (Chen, 2003). Paddy rice best grown in clay soils which are always impermeable to reduce percolation loss. Soil texture has a strong influence on the magnitude of seepage and percolation losses (Wicham, 1978).

Puddling is considered to be a pre -requisite for successful rice production as its strong influence on percolation losses and enhancing characteristics of water use efficiency (Singh *et al.*, 2008). Percolation rate in extremely light soils (clay content <8%) is 0.73 cm/day, Light soil textures (clay content 8-16%) is 0.54cm/day, Medium soil textures (clay content 16-44%) is 0.32cm/day and Heavy textured soils (clay content >44%) is 0.15 cm/day. (Teimour, 2014). Percolation rate in non-puddled soils is 0.6-2.5mm/day and in puddled soils 0.2-2.1mm/day (Yoichi *et al.*, 2013). Field measurements indicate that the reduction by Puddling reduces percolation losses to about one third of those in non-puddled soils (Wickham and Singh 1978). A paddy soil condition that permits percolation rate of 10-20 mm irrigation water day^{-1} was recommended in order to get higher yields of rice (Aimrun *et al.*, 2002). The measurement of percolation rates of different soils in different regions is essential to design and formulate seed bed preparation techniques of paddy field. An attempt has been made to measure the percolation rates of the conventional paddy fields by using rapid response percolation meter to study the behavior of soils in percolating water.

MATERIALS AND METHODS

This study was conducted in six conventional paddy fields at Sangareddy of Telangana state. Three fields 1,2 and 3 are having heavy clay soils and the remaining fields 4, 5 and 6 are loamy clay soils. Percolation rate is measured in six different paddy fields by using rapid response percolation meter (IRRI, 1987).

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Equipment details

The rapid-response percolation meter (Fig.1) includes a cylinder of cross-sectional area 136.84 cm^2, a transparent tube cross sectional area 0.5024 cm^2, angle rod, scale of 1.5m with 1mm graduations, a wash bottle and a stop watch. Sometimes the cylinder may be noncircular, with an area different from 136.84 cm^2, although that size can set easily between hills and allow easy calculation of the percolation rate. The cross-sectional area for the transparent tube is usually 0.5024cm^2, but the area may be changed to suit a particular percolation rate.

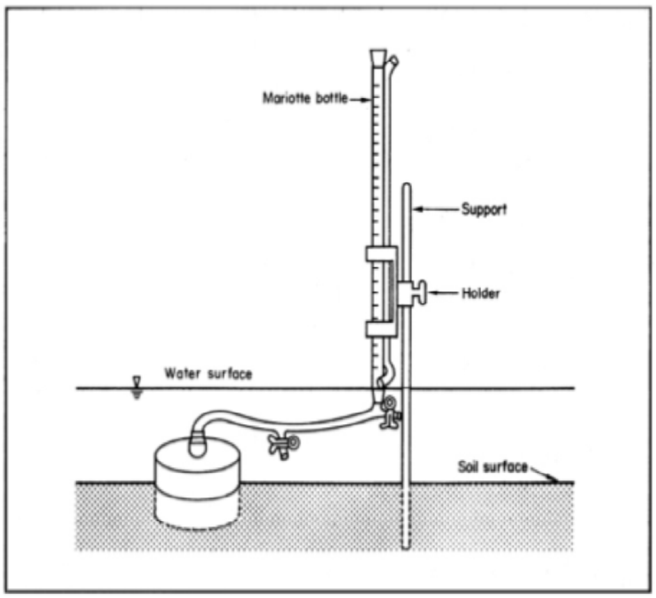

Figure 1: Rapid response percolation meter

The amount of water that percolates through the cylinder is equaled by the amount that passes through the transparent tube. Because the cross-sectional areas of cylinder and tube are so different, the rate of movement of the air-water interface in the transparent tube gives a much-magnified representation of the water percolation rate into the soil. By using the rapid-response percolation meter, it is possible to obtain the percolation rate within a few minutes, and calculate the rate using the equation. The rapid response percolation meter installation setup is shown in the Fig.1. Percolation rate can be measured by using the equation 1.

$$P= (1440*X*a)/(A*t) \qquad (1)$$

Where p is the percolation rate (mm/day), a is the cross-sectional area of the transparent tube (cm^2), A is the cross-sectional area of the cylinder (cm^2), and X (mm) is the distance moved by the air-water interface in the transparent tube in time t (min).

Procedure to measure percolation rate

1. Carefully insert the cylinder vertically into the soil until it is stable, trying to reach the hard pan if there is one. If the flood water is too shallow for the water supply port to be underwater, fill the cylinder by pouring water into the port with the washing bottle.
2. The transparent tube is attached to the angle iron rod which is fixed with a Scale.
3. Fill the transparent tube with the water and attach one end of the transparent tube to cylinder and other end is opened which is fixed to angle rod.
4. Measure the percolation rate by checking the graduated scale and recording the distance moved by the air water interface during 1min repeat the measurement until the values become constant.

Plate 1: Installation of rapid response percolation meter in the field

Plate 2: Measurement of percolation rate

RESULTS AND DISCUSSION

Percolation rate which was measured in six conventional puddled wet rice fields by rapid response percolation meter is as shown in below Table 1.

Table 1
Percolation rates of the conventionally puddled wet rice fields

Field No.	*1*	*2*	*3*	*4*	*5*	*6*
Percolation rate (mm/ day)	35.596	35.596	37.008	14.803	20.794	16.918

From the table 1 it is observed that the percolation rates of 1, 2, 3 fields are 35.596, 35.596, 37.008 and 4, 5, 6 are 14.803, 20.794 and 16.918 respectively. Here it is inferred that the percolation rates are affected by type of soil which is more in clay loamy soils compared to heavy clay soils. It is also observed that the percolation rates are very high (37.008mm/day) as compared to ideal paddy field percolation rates (2 mm/day) which may be because of less hardness of the hardpan obtained in the conventional puddling practices. Fig. 2 shows the variation of percolation rates in different fields with time.

Fig 3. Plot represents the average percolation rate and time in Heavy and clay soils. It is clear from the above figure that the percolation rate is low in heavy clay soils as compared to clay loam soil.

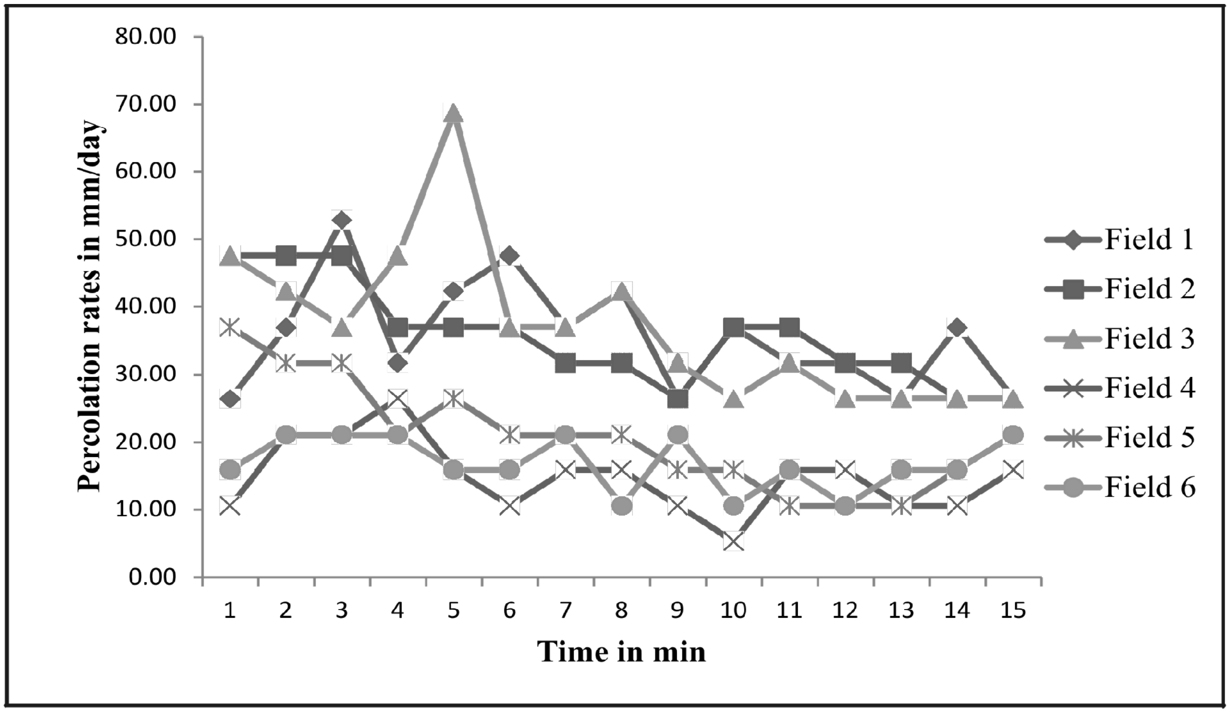

Figure 2: Plot of percolation and time in six paddy fields

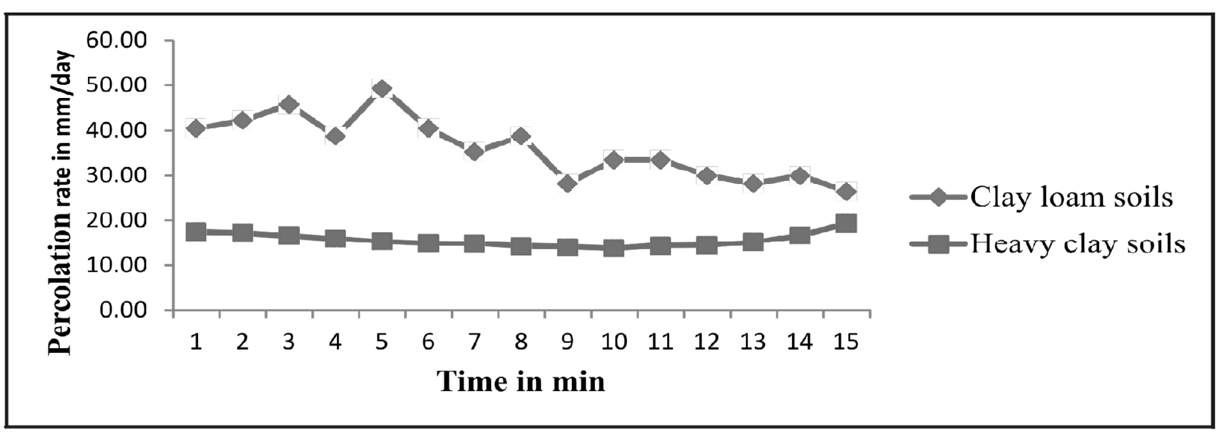

Figure 3: Plot of percolation rate and Time in heavy and clay soils

CONCLUSIONS

In this study, rapid response percolation meter was used for measurement of percolation rate in six conventional paddy fields. Results showed that the percolation rate is low in heavy soils compared to clay loamy soils. It is also observed that the percolation rates are very high (37.008mm/day) as compared to ideal paddy field percolation rates (2 mm/day) which may be because of less hardness of the hardpan obtained in the conventional puddling practices. Hence, Developing of machinery for seed bed preparation of paddy is highly essential to enhance the productivity of the land and also to conserve the resources.

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