Research Article

MOISTURE WETTING PATTERNS IN SURFACE AND SUBSURFACE DRIP IRRIGATION SYSTEMS

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KEYWORDS:

Emitter spacing, Lateral placement, Soil moisture, Surface drip

ARTICLE INFO

Received on: 27.09.2019
Revised on: 07.02.2020
Accepted on: 14.02.2020

ABSTRACT

Soil moisture patterns from emitters are important for the design and management of drip irrigation systems. The soil moisture distribution pattern around an emitter depends on depth of lateral placement, emitter spacing, duration and frequency of water application, soil physical and hydraulic properties. This experiment was carried out at Agricultural Research Station, Bhavanisagar. Soil moisture measurements were carried out using soil moisture meter after irrigation at different horizontal and vertical distance (0, 15, 30 and 45 cm). The results indicated that the soil moisture distribution within the soil profile under subsurface drip was to great extent affected by the distance between drippers and variations in discharge. It was also found that, soil moisture distribution varied with variation of lateral location from the soil surface. Soil moisture movement was found to be higher at lower depth of laterals placed at 15 and 30 cm depth.The gradual increment in the moisture content around the dripper was found at the surface layer and vertical layer with increasing the measuring time up to 2 hr at 15 and 30 cm lateral depth. The measurements of soil water content at 2hr indicated that the lower soil layer was the one with higher moisture content at 30 cm depth of placement of lateral irrespective of discharge. Dripper spacing of 30 cm with dripper discharge of 2LPH at 30 cm depth of placement of lateral was found to be higher in soil moisture content of more than 27.2 per cent than of that under 15 cm.

INTRODUCTION

Subsurface drip irrigation systems are becoming increasingly popular because of supplying irrigation water and fertilizers, and pesticides more efficiently (Camp, 1998; Singh *et al.,* 2006). Proper design and management of sub-surface drip irrigation system requires knowledge of distribution of water around the emitters, also in the crop root zone Skaggs *et al.* (2004). Operational parameters such as the frequency and duration of irrigation, the emitter discharge rate and spacing, and the placement of the drip laterals greatly decides the wetting front and soil water content (Kandelous and Šimůnek, 2010). This study aims to find out the dimensions of wetting patterns from the subsurface emitter and soil water content by varying irrigation time.

MATERIALS AND METHODS

Field experiment was conducted at Agricultural Research Station, Bhavanisagar, Tamil Nadu in sandy loam soil with the aim to find out the horizontal, vertical downward, and vertical upward directions of wetting patterns from the subsurface emitter and soil water content by varying irrigation time. Laterals were placed at 15 cm and 30 cm below the ground level with constant lateral spacing of 1.5m and emitter spacing of 60 cm with 4 LPH dripper discharge. The soil profile was uniformly dry before the irrigation. Irrigation water was applied till overlapping of wetting pattern. At the end of irrigation, the soil around the emitter along the lateral was dug out, and the maximum distance of the wetting front from the emitter was measured in the horizontal, vertical downward, and vertical upward directions. Soil water content was measured using soil moisture meter after irrigation at different horizontal (0, 15, 30, 45 and 60 cm) and vertical distance (0, 15, 30, 45 and 60 cm).

RESULTS AND DISCUSSION

This study revealed that the wetting front in the horizontal, vertical downward, and vertical upward directions was affected greatly by irrigation time. With increasing supply of water, depths and width of wetted zone soil increased. Similar trends of effects were also observed in all the depths of placement of subsurface drip irrigation system. As the irrigation time increased and the wetting patterns from two emitters started overlapping. Wetting front was overlapped after 6th hour of irrigation (24litre/emitter). When the wetting front reaches the soil surface, downward water movement increases. At 30 cm depth of lateral placement, wetting front reached to a depth of 32 cm at vertical downward and upward direction, and horizontal direction to the distance of 30 cm after 24 litre of water was supplied. In the case of 15 cm depth of lateral placement, wetting front at vertical downward direction to the depth of 40 cm, and horizontal direction to the distance of 27 cm after 24 litre of water was supplied (Fig. 1). Soil water content was recorded after irrigation, one day and two days of irrigation using soil moisture meter at different vertical and horizontal distances. At 15 and 30 cm depth of lateral placement 21.5 and 25.8 per cent of soil content was recorded immediately after irrigation (Fig. 2). Similar decreasing pattern of soil water content was observed one day and two days after irrigation. Soil water content was found to be higher at depths where laterals are placed and it decreased as depth increases.

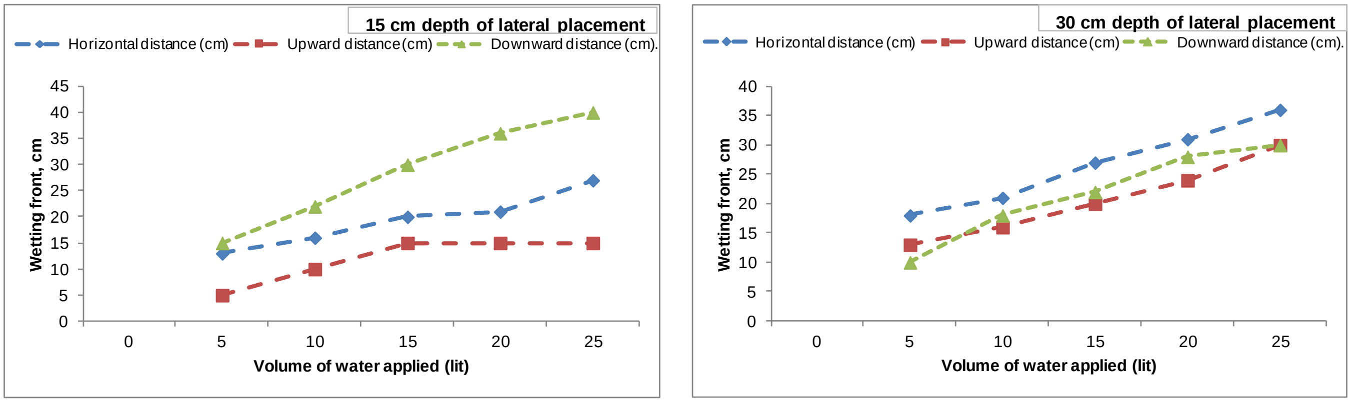

Figure 1: Measured wetting dimensions for subsurface drip irrigation

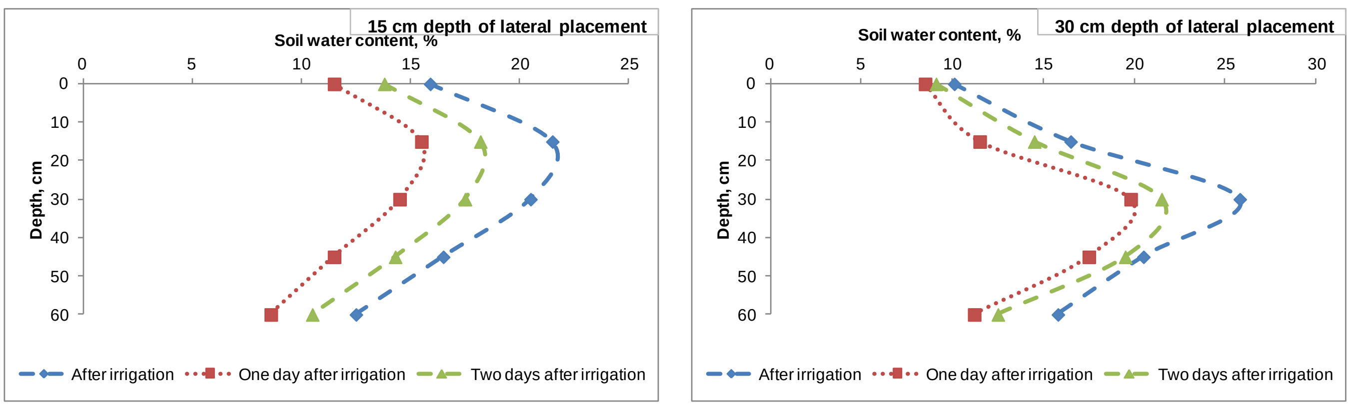

Figure 2: Measured soil water content (%) for subsurface drip irrigation

CONCLUSION

From this study it can be concluded that the dimensions of wetting pattern under subsurface irrigation was greatly affected by irrigation time. Optimal wetting pattern by optimizing irrigation time helps to avoid excessive wetting of the soil surface and high percolation to the groundwater. Higher soil water content observed at depths where laterals are placed even after two days of irrigation indicates the frequency of irrigation.

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How to cite this article?

Thiyagarajan, G., Manikandan, M., Nagarajan, M., Natarajan, S.K., 2020. Moisture wetting patterns in surface and subsurface drip irrigation systems. *Innovative Farming* 5(1): 15-16.