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Infiltration and hydraulic behaviour of an anguiform furrow in heavy texture soils of Iran

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Surface irrigation is used in smooth and land-levelled areas. Since land levelling is costly and it is not technically feasible in sloping lands, farmers in these areas in the Islamic Republic of Iran use anguiform (snake-shaped) furrow in traditional fashion instead of a straight furrow, particularly in heavy texture soils. Hydraulic and geometric parameters are different for anguiform furrow irrigation compared with the straight furrow irrigation. Research was conducted to determine the parameters of the Lewis–Kostikov infiltration equation and flow hydraulic and geometric parameters for an anguiform furrow in comparison with those for a straight furrow irrigation. The furrow geometric parameters were found to be variable in various furrow types and irrigation events. Differences were more pronounced between irrigation events than between furrow types. The Manning roughness coefficient in the anguiform furrow with real flow path was lower than that in the straight furrow in both the first and the next irrigations. The recession time in the anguiform furrow is higher due to greater water storage in upstream end stations. The basic infiltration rate in the anguiform furrow is higher (22 and 48% in the first and the next irrigations, respectively) than that in the straight furrow. The infiltration coefficients k were higher (two orders of magnitude) and the exponents a are smaller (about half) in the anguiform furrow than the straight furrow. Further more, it was indicated that the flow hydraulics in the anguiform furrow can be estimated by Fok–Bishop equation using the water surface hydraulic gradient, corresponding furrow geometry parameters and infiltration equation with the real water flow path.

1. Introduction

Energy scarcity and high cost are the main obstacles for the use of pressurised irrigation. Surface irrigation is usually preferred because of its lower energy and cost requirements. However, the lower efficiency of surface irrigation restricts its use. Furthermore, straight surface irrigation is not applicable on sloping lands. Innovative surface irrigation techniques can be used for higher irrigation efficiency: the irrigation of alternate furrows decreases deep percolation and reduces soil surface evaporation, thereby increasing water-use efficiency (Sepaskhah & Kamgar-Haghighi, 1997; Sepaskhah & Khajehabdollahi, 2005; Sepaskhah & Parand, 2006; Kang *et al.*, 2000). Since land levelling is costly and not technically feasible in sloping lands, farmers in these areas of the Islamic Republic of Iran use anguiform furrow irrigation in a traditional fashion in the direction of the slope (Fig. 1). However, there are no data available to present for the slope and the area of the heavy texture soil on which farmers use the anguiform furrow irrigation. In this furrow irrigation, since water flows with a lower velocity, it produces greater wetted perimeter, higher infiltration in soil and less run-off on sloping lands

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