Surge flow irrigation: Technique to increase irrigation efficiency and Water productivity in short furrows


Abstract:

Surge flow irrigation is a technique in furrow irrigation that can contribute to improve application efficiencies and distribution uniformity with diminished water and sediment losses. Literature reviews show that surge flow irrigation may decrease water use and increase crop production. Several studies which were carried-out in long furrows have shown that surge flow irrigation offers the potentiality of increasing the efficiency of irrigation, however the effects of surge flow in short furrows are still not well known. To investigate the effect of surge flow irrigation in short furrows a series of experiments have been carried-out on four soil types at two countries, Egypt and The Netherlands. The first location in Egypt was on clay soil at the Agriculture Experimental Station, Assiut University, Assiut. The second location was on sandy soil at Assiut University Experimental Station for Desert Land, El-Wadi El-Assuity, Assiut. The experiments under the Netherlands conditions were carried out at the Tunnel experimental setting of the Irrigation and Water Engineering Group, Wageningen University. Two soil types were classified inside the tunnel, sandy clay and sandy clay loam soils. The blocked end furrow lengths and widths were 70 and 0.70 m respectively. One discharge was selected for each soil type, namely 0.74 l/s for clay soil, 1.0 l/s for sandy soil and 0.76 l/s for sandy clay and sandy clay loam soil. For each discharge two cycle times were investigated, namely 16 and 24 minute. For each cycle time three cycle ratios were chosen, 1/4, 1/2 and 3/4 for 16 minute and 1/3, 1/2, and 2/3 for 24 minute cycle time. The water content was measured at three locations, namely at the beginning, middle and end of the furrow. In each location three points were measured in a vertical line at a depth from 0 - 0.1, 0.1 - 0.3 and 0.3 -0.7 m. Crop yields was simulated in relation to water supply for clay and sandy soils using the cropwat model The results showed that surge flow irrigation lead to more uniform water distribution along the furrows than continuous flow. Also, surge flow irrigation decreased the advance time in comparison to continuous flow. The reduction in advance time was more pronounced in clay, sandy clay and sandy clay loam soil than sandy soil. The 24 minutes cycle time was better than the 16 minutes cycle time. The reduction in advance time with cycle time of 24 minutes is due to the effect of the off-time. Different cycle ratios may be used however the 1/3 cycle ratio was the best. The simulation results of cropwat model indicated that using optimal surge flow irrigation to simulate crop yield was better than using optimal continuous flow. Using optimal surge flow irrigation in the simulation revealed distinct differences in yield reduction between continuous and surge flow irrigation compared to the results based on optimal continuous. In conclusion surge flow irrigation under short furrows decreased the advance time, increased uniformity and efficiency by decreasing deep percolation and it reducing applied water volume 15% to 35 %. Surge flow irrigation is an efficient tool to produce higher yields than continuous flow by using the same gross irrigation supply

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