Guidelines for Optimal Irrigation Management for Blocked-end Irrigation Borders

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Abstract. Nowdays, there is a concern about global warming impact in human health, biological, environmental, and agricultural aspects. The mean daily temperature increment is a global warming effect; consequently, high evapotranspiration from crops will require more water for their growing. If the freshwater scarcity is also considered due to increment of world population, irrigation needs to be applied efficiently avoiding water loss due to deep percolation and satisfying crop water requirement. On-farm irrigation management is a crucial key to diminish the negative effects of the global water warming. There are several ways to reach an efficient on-farm irrigation management; 1) minor improving of irrigation practices (handling the irrigation time to avoid surface runoff 2) switching of irrigation methods (from surface to drip or sprinkler irrigation methods), 3) automating irrigation in basis of soil and plants needs (using soil moisture sensors). From all these ways, minor improving of irrigation practices constitutes less investment; therefore, it is more accessible for farmers around the world. Guidelines for on-farm irrigation management need to be updated and applied to alleviate future water issues. In addition, sloping borders represent a significant portion of the world's surface-irrigated areas and the management of water using this method can benefit from operational guidelines based on modeling studies and mathematical optimization.

From a robust mathematical model of one-dimensional flow for border irrigation, the downhill simplex optimization method algorithm was incorporated to determine the recommended inflow rate and irrigation cutoff time, maximizing a composite irrigation efficiency (water requirement efficiency and application efficiency). Different optimum values of inflow rate and irrigation cutoff time for a range of longitudinal slopes, border lengths, and soil types were generated. Most of the optimum values are for relatively high inflow rate and rapid cutoff time (irrigation time). In addition, exponential relations were developed, based on the simulation results, to determine the best irrigation time for maximization of the composite irrigation efficiency for specified, non-optimal inflow rates. The exponential relations are particularly useful in practice when it is not feasible to use the optimum inflow rate due to constraints at the water source, or because of irrigation scheduling issues.