A Report-Generating Computer Program for Evaluation of Field Drip Irrigation Systems

Bedaiwy, M.N.

Dept. of Soil and Water Sciences, Faculty of Agriculture, Alexandria University, Alexandria, Egypt

Received on: 28/2/2010 ***Accepted: 3/4/2010***

ABSTRACT

A computer program for evaluation of field drip irrigation system is introduced. The program provides fast and accurate calculations of various evaluation parameters. The program is constructed such that it is capable of generating an evaluation report with system and situation description, remarks and recommendations. Evaluation parameters determined by the program include distribution uniformity (*DU*), emission uniformity (*EU*), low quarter potential and actual application efficiencies (*PELQ* and *AELQ*, respectively), system potential and actual application efficiencies ($PELQ_{system}$ and $AELQ_{system}$, respectively), wetted area percentage (*P*%), and average application depths (for wetted area D_{aw}, overall D_a, and minimum, D_n). This enables the grower or irrigator to progressively improve the system as it operates. Evaluation tests showed consistent response of the program to successive changes in the system (deterioration as well as improvements) and evaluation reports appeared to give the appropriate recommendations for every situation. It is believed that the program can be used as a useful tool for improving the performance, hence the efficiency, and management competence of field drip irrigation systems.

Key words: drip irrigation, trickle irrigation, irrigation evaluation, irrigation efficiency.

INTRODUCTION

Since it was first introduced in the early 60s of last century, drip (trickle) irrigation has been the subject of extensive examinations and studies, involving its design, operation, efficiency and management principles (e.g. Keller and Karmeli 1975); Goldberg *et al.* (1976); (Merriam and Keller 1978); Howel *et al.* (1981); (Nakayama and Bucks 1986); (Keller and Bliesner 1990). Advantages, disadvantages, and effects on the crop yield under different regional and climatological conditions were the objectives of numerous studies throughout the world (e.g. Schweers and Grimes 1976; Maber 1979; Mostaghimi *et al.* (1981); (Pai Wu 1982); (Armstrong and Wilson 1982); Oron *et al.* (1982); (Wamble and Farrar 1983); (Oron 1984); Tekinel *et al.* (1989); (Çetin 1997); (Ertek 1998); (Keser 1998); (Senyigit 1998). Ever since trickle irrigation was accepted as a new standard method of irrigation, it has undergone many improvements and enhancements (Jobling 1973); (Bucks and Davis, 1986); (Tekinel and Kanber, 2002) and the components of trickle systems were markedly augmented, namely emitters and piping designs and materials, pumps, and filters. Emitters in particular have recently developed significantly. Many new highly efficient designs and more durable and reliable material emitters became available and are now successfully used across the world.

Drip irrigation is based on high frequency–low volume, localized deliverance of water over a long period of application time, utilizing low-pressure for operation Hagan *et al*, (1967), (Bucks and Davis 1986), (Tekinel and Kanber, 2002). In drip irrigation systems, water is conveyed to the soil near the plant through a pipeline network where it is delivered directly into the plant's root zone through emitters (drippers) or injectors. Water leaves the dripper at zero pressure and gravity moves it to the soil and downward.

Although drip irrigation has several advantages over other types of irrigation, it is very susceptible to problems and drawbacks. The fact that water is delivered to the soil through small orifices makes incessant maintenance of emitters (i.e. cleaning, testing, replacing, etc.), and closely-watching the system in general, crucial issues for successful operating. Emitters are constantly exposed to damage, clogging or malfunctions. Emitter clogging, which represents a common and severe problem, can be caused by a variety of factors (van't Woudt, 1969); Davely *et al,* (1973); (Booher, 1974) including salt accumulation, particularly when irrigation water contains significant quantities of calcium or magnesium bicarbonates. These salts lead to the formation of carbonate encrustations on the outer side of the orifices, reducing the flow of water. Also, water containing dissolved iron may precipitate iron oxides and plug the outlets. Fertigation, or the injection of fertilizers such as phosphates or ammonia into irrigation water, could result in the formation of precipitates of calcium or magnesium compounds, leading to clogging of emitters or flow orifices. The growth of algae or filamentous bacteria inside the supply tubing can also plug orifices or emitters (Booher, 1974).

Trickle systems involve the use of plastic pipes that are prone to cracking, tearing, deterioration, or collapse which drastically affect their performance (Davely *et al,* (1973), (Booher, 1974).