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Hydraulic performance of manually operated drip irrigation system

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ABSTRACT

In drip irrigation system the hydraulic parameters such as pressure discharge relationship, manufacturing coefficient of variation, mean flow rate deviation, coefficient of discharge, emitter discharge exponent, field emission uniformity and absolute emission uniformity can be used for the design, operation and selection of the irrigation system. The field experiment was conducted to evaluate the performance of manually operated drip irrigation system for different types of emitters. For the experiment three different types of emitter's *viz*. 2 lph, 4 lph and 8 lph were fitted on three laterals each of 10 m length. The emitters and lateral spacing was 1 m. The system was operated at varying pressures between 0.4 to 1.4 kg/cm^2 with an increment of 0.2 kg/cm^2. The emitter flow rate was measured in the catch cans. Results show that the emitters based on the hydraulic parameters were characterized as average. The field and absolute emission uniformity was above 90 %. The system performed better in the range of 0.6 to 1.0 kg/cm2 with highest emission uniformity. The overall quality of emitters was better for high nominal discharge rates. These hydraulic parameters of emitters evaluated can be used for the design, operation and selection of the irrigation system. The manually operated system thus can be used form small farms.

Key words : Emission uniformity, Emitting devices quality, Pressure-discharge relationship, Mean flow rate deviation and emitter discharge exponent

Agriculture sector contributes nearly 35 per cent of national income and engages 70 per cent of Indian population. Water is the most vital input in agriculture and has made a significant contribution in providing stability to food grain production and self-sufficiency. Efficient utilization of available water resources is crucial for a country like India, which shares 17 % of the global population with only 2.4 % of land and 4 % of water resources. In Maharastra while 80 % cultivable land depends on rainfall, efficient utilization of available water resources in the state is crucial for its agricultural development (Anonymous, 2006). Irrigation meets the water demands of plants by replenishment of root zone when natural rainfall is inadequate or poorly distributed. Within a field, irrigation water needs to be distributed uniformly to all plants. However, in most cases non-uniformity in irrigation water supply is the major source of reduced crop yields (Wu, 1987; Bhatnagar and Srivastava, 2003).

On the contrary, drip irrigation system can apply frequent and small amounts of water at many points in the field with minimum losses and maintaining steady moisture in the soil profile. In addition, drip irrigation system is best suited for difficult topography (Decroix and Malaval, 1985; Youngs *et al*., 1999 and Wei *et al*., 2003) and offers the highest irrigation uniformity compared to other irrigation methods. A successful uniform drip irrigation system application depends on the physical and hydraulic characteristics of the drip tubing (Al Amound, 1995). Efficiency of drip irrigation system depends on application uniformity which can be evaluated by direct measurement of emitter flow rates. According to Mizyed and Kruse (1989), the main factors affecting drip irrigation uniformity are manufacturing variations in emitters and pressure regulators, pressure variations caused by elevation changes, friction head losses throughout the pipe network, emitter sensitivity to pressure, irrigation water temperature changes and emitter clogging. Similarly, Capra and Scicolone (1998) indicated that the major sources of emitter flow rate variations are emitter design, the material used to manufacture the drip tubing and precision.

The uniformity and general performance of drip irrigation systems are affected by hydraulic design, emitter manufacturer's coefficient of variation, grouping of emitters, and emitter clogging amongst other factors (Mofoke *et al.,* 2004). Coefficient of variation gives more critical interpretation of hydraulic characteristics as compared to emission uniformity (Mokashi *et al*., 1998). Most of the time actual coefficient of variation was higher than those claimed by manufacturers for pressure compensating emitters (Ozenkici and Sneed, 1995) hence the design should be base on reliable test data and not on data supplied by manufacturers.