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Hydraulics of micro-sprinkler irrigation system

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ABSTRACT

Three different commercially available makes of micro-sprinkler of nozzle size 1.3 mm were tested at 30 cm stake height for their hydraulic performance in terms of pressure discharge relationship, manufacturer's coefficient of variation and precipitation pattern for the operating heads from 1.0 to 2.4 kg/cm^2. Power equation of form $Q = aH^b$ were developed for all three micro-sprinklers to describe the pressure discharge relation ship. On the basis of this relationship, SP-3 was found superior over other two. Manufacturing precision was estimated in terms of manufacturer's coefficient of variation. Micro-sprinkler SP-2 and SP-3 recorded values in the range of 0.02 to 0.06 and 0.015 to 0.034 at different operating pressures, respectively reflecting better precision in their manufacturing whereas micro-sprinkler SP-1, recorded the value in the range of 0.28 to 0.41 indicating its poor manufacturing quality. Precipitation pattern was studied for all the three micro-sprinklers under study according to the procedure suggested by Keller and Bliesner (1990) in terms of distribution profile, effective radius, average application depths, effective maximum depth, absolute maximum depth, mean depth, distribution characteristic and coefficient of variation. These characteristics indicated the superiority of SP-2 type of micro-sprinkler over other two types of micro-sprinklers under study.

Key words : Micro-sprinklers, Pressure-discharge relationship, Manufacturer's coefficient of variation, Precipitation characteristics

The total area under irrigation in Maharashtra is only 16 % and it is estimated that after full development of water resources, the irrigated area in the state may not exceed 30 % if we continue to adopt the conventional surface irrigation methods (2nd Irrigation Commission Report, 1976). As the productivity of irrigated agriculture is more than 2-3 times the productivity of rainfed agriculture, there is a need to increase the area under irrigation to meet the food requirement of continuously growing population. However, as we have already tapped the easily and cheaply available water resources, the cost of creating additional water resources is huge. Hence, the appropriate alternative is to increase the productivity of irrigated agriculture by adopting irrigation methods that utilise the irrigation water efficiently to bring more area under irrigation. The previous studies on use of micro-sprinkler irrigation have indicated an increase in crop yield and water saving for cole crops (Singh *et al.*, 1990; Kabra, 1994). It is therefore, necessary to promote the adoption of micro-irrigation methods such as drip and micro-sprinkler. The crop yields depend on the parameters such as uniformity of water application and water application rate that matches with infiltration rate of soil and if designed properly in terms of spray, stake height and pressure, the system has the ability to apply the water with high uniformity and provide the application rate that matches with infiltration rate of soil. The micro-sprinkler irrigation method provides low adjusted discharge. However, in case of micro-sprinkler irrigation system, these parameters are governed by the spacing between micro-sprinklers, pressure, etc. The study was, therefore, undertaken to know the pressure-discharge relationship, manufacturer's coefficient of variation, precipitation pattern and distribution uniformity for the micro-sprinklers of different make that were differentiated by means of nozzle size of micro-sprinkler.

METHODOLOGY

The experiment was conducted at the Instructional Farm of the Department of Irrigation and drainage Engineering, Rahuri during 2002-03. The objectives of the study was fulfilled with the help of following techniques and data. Three rotating head type micro-sprinklers (SP-1, SP-2 and SP-3) of nozzle size 1.3 mm at the stake height of 30 cm were used for obtaining pressure discharge relationship and precipitation characteristics. The details of micro-sprinklers used in study were as under,

Makes name and code no.	Recommended pressure range (Kg/cm^2)	Nozzle size (mm)	Discharge range (lph)	Stake height (cm)
Jain-SP-1	1.00 to 2.00	1.3	69.0 to 93.0	30.0
Plastro-SP-2	1.50 to 2.50	1.3	44.0 to 56.0	30.0
EPC-SP-3	1.05 to 2.10	1.3	52.9 to 75.2	30.0