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Water application uniformity as affected by operating pressure and micro sprinkler spacing

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ABSTRACT

Five different types of microsprinklers (coded for identification as MS-1, MS-11, MS-111, MS-IV and MS-V) were evaluated at various microsprinkler spacing (3 m x 3 m, 4 m x 4 m, 5 m x 5 m, 6 m x 6 m, 7 m x 7 m and 8 m x 8 m, 9 m x 9 m and 10 m x 10 m) and operating pressures (1.0, 1.5 and 2.0 kg/cm^2). The depth distribution data obtained from the experiment was analysed for Christiansen's Uniformity Coefficient (UCC) and Merrium and Keller Distribution Uniformity (DU). At the rated pressure (2 kg/cm^2), the maximum value of UCC (94.74%) was recorded for MS-V at 3 m x 3 m microsprinkler spacing followed by MS-III (92.5%), MS-II (92.06%), MS-I (91.01%) and MS-IV (87.52%) at the same pressure and spacing. More than desired value (70%) of UCC was reported only for MS-I for all pressures under consideration and for spacings 3 m x 3 m to 7 m x 7 m which indicates its superiority over other types of microsprinklers. A fairly good value of DU (78.00 %) was recorded at all pressures and at 3 m x 3 m and 4 m x 4 m spacing for all the microsprinklers except MS-IV. At rated pressure, the DU values recorded for MS-I, MS-II, MS-III, MS-IV and MS-V were 91.47, 96.90, 92.61, 91.35 and 96.75 %, respectively.

Key words : Micro sprinkler, Uniformity, Coefficient, Operating pressur DU.

The degree of uniformity obtainable with a sprinkler system depends largely on the water distribution pattern and spacing of the sprinklers (Keller and Bliesner, 1990). If the microsprinkler system is operated in low wind condition, during morning or evening hours, the effect of wind velocity and direction on uniformity of water application can be minimized however microsprinkler spacing and operating pressure becomes the devastating factors in affecting the uniformity.

The information, on effect of these factors on uniformity coefficient, need to be generated for commercially available makes of microsprinklers. This information will be helpful for engineers for choosing the type of sprinkler and working conditions (operating pressure, sprinkler spacing, etc) in order to achieve high water distribution efficiency.

MATERIALS AND METHODS

The experiment was conducted in College of Technology, G.B. Pant University of Agriculture and Technology, Pantnagar for uniformity evaluation of five different makes of microsprinklers, designated as M-I, M-II, M-III, M-IV and M-V, at different pressures and spacing combinations.

The guidelines given in American Society of Agricultural Engineers Standard, ASAE-S 330.1- "Procedure for sprinkler distribution testing for research purpose (ASAE, 2003) and Indian Standards: BIS (1984) were used for the study.

Experiment was conducted on the concrete floor having slope less than 2 per cent. The tests were conducted during early in the morning and late evening hours, as drifting and evaporation losses were the minimum due to lower sunshine and wind velocity. The catch cans were placed in rectangular array at the spacing of 0.5 m x 0.5 m and the observations on water collected in catch cans during one hour was recorded. The quantity of water collected in catch cans was measured and converted into precipitation rate, mm/h. Keeping in view the recommended operating pressure range for all types of microsprinklers, three operating pressures 1.0, 1.5 and 2.0 kg/cm^2 were selected for studying their effect on various uniformity coefficients. The riser height of 35 cm was kept constant for each observation.

Overlapping patterns and uniformity of water application

The emitting device, either sprinkler or microsprinkler, apply water in circular manner to obtain radial wetted area. Under normal condition each quarter of the circle receive same depth of water. Considering this, the distribution characteristics and uniformity coefficients for one-quarter area were developed utilizing the depth distribution data of a single nozzle and the