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Effect of perimeter on flow rate and pressure reduction in a helical flow path designed for non pressure compensating drip emitters

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Appropriate designs of water emitters are critical to all micro irrigation systems. Commercially available emitters could be categorized into two main areas based on the discharge with respect to the operating pressure, namely, pressure compensating, and non pressure compensating emitters. Short-path emitters or flag emitters are non pressure compensating emitters which have a shorter and smaller helical water path having a laminar flow operated under very low-pressure systems with poor water distribution uniformity and tend to clog up easily. Due to these reasons, no studies have been carried out to study the effect of perimeter on flow and pressure regulations in short path emitters. Present research focuses to determine the effect of perimeter on flow rate and pressure in a helical flow path designed for non pressure compensating emitters.

Two emitters were fabricated to have a free space as a flow path in between the nut and the stud. Space or the flow path was created by varying the thread angle (100, and 133 Deg) of the nut, and the thread angle of the stud (40, and 48 deg) while keeping the nut diameter (20.2 mm) and the stud diameter (19.4 mm) as constant values. Area and the length of the flow path were also kept constant for 0.30 mm^2 and 1.393 m respectively. Perimeters of the flow path were measured as 3.52 mm, and 8.09 mm respectively with reference to the nut and stud angles. Centrifugal pump with a bypass valve was used to apply three different pressure levels (0.5, 1, 1.5 bar). Flow rate of emitters was measured for 1 minute duration using a measuring cylinder and a stopwatch. A filter was used to control the water quality received by emitters. Emitters were tested, one at a time with four replicates for each pressure level. Experimental data verification was done by comparing experimental discharge values with theoretical discharge values computed using Hazen-Williams and Manning equations.

Results revealed that there is a positive correlation of flow and pressure reduction with the perimeter of the flow path. Emitter which has the highest perimeter 8.097mm showed higher reduction of flow compared to the emitter having perimeter of 3.526mm. Hazen-Williams and Manning equations over predicted the experimental results. Therefore it can be concluded that, flow rate could be controlled by changing the perimeter of the flow path and further experimental investigations are needed.

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