OPTIMIZATION OF MAXIMUM LATERAL LENGTH (MLL) FOR GRAVITY-FED DRIP IRRIGATION SYSTEMS

By

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ABSTRACT

Hydraulic calculations have not been directed to develop a suitable design procedure of a low head gravity-fed drip irrigation system. Therefore, an experiment was conducted on a leveled field to analyze the impact of key design factors such as head of the system, emitter spacing, rated discharge capacity, emitter type and form of the emitter on Maximum Lateral Length (MLL) which was defined as the length within 5% flow variation is allowed in a low head drip system.

Four overhead tanks of 500L capacity each were arranged at four different heights of 5 m, 3.75 m, 2.5 m and 1.25 m above the ground level in order to obtain a pressure head of 0.5 bar, 0.375 bar, 0.25 bar, and 0.125 bar, respectively. Low-Density Polyethylene (LDPE) tubes of 16 mm diameter were used as laterals and they were laid along levelled beds. The first set of twelve (12) lateral lines was provided with In-line non- pressure compensated (NPC) type emitters having 1 LPH rated discharge capacity. The four emitters were spaced at 0.2 m, 0.3 m, 0.5 m and 0.75 m with three (03) replicates of each. The second set of twelve (12) laterals was pre-fitted with In-line non-pressure compensated emitters of 2 LPH rated discharge capacity. They also were laid at four emitter spacings as earlier (0.2m, 0.3m, 0.5m and 0.75m) and with three (03) replicates each. The third set of twelve (12) lateral lines was fixed with On-line non-pressure compensated type emitters of 3.75 LPH rated discharge capacity and were arranged at four emitter spacings of 0.5 m, 0.75 m, 1.0 m and 1.25 m and with three replicates each. On-line pressure-compensated type emitters of 4 LPH rated discharge capacity were fixed to the last set of twelve (12)

laterals. Those emitters were arranged at four spacings of 0.5 m, 0.75m, 1.0m and 1.25 m with three replicates each.

Three crops were cultivated to study the effect of irrigation on agronomic variables. Yield data of individual crop along a lateral was collected.

Discharge rate of each emitter was measured by volumetric method. From the measured emitter flow rates, percent flow variation of each lateral length was determined. Maximum Lateral Length (MLL) were taken by reducing length of lateral by 1m each time and measuring the flow variation till their respective values were less than or equal to 5%. The mean values of MLL against their treatment levels were statistically analysed using SAS and GLM.

The impact of each individual variable on MLL was analyzed to develop respective design equations for different emitter combinations. Then a complete model of selected design factors was developed without their interactions to see the comparative weightage of each on MLL. Furthermore, a complete model of design factors with their interactions was analyzed to improve the precision of those design equations. Finally, three design equations of head and spacing were derived for any predetermined emitter combination.

The results revealed that In-Line NPC emitters maintain the highest MLL for a given head level. It was observed that, In-Line emitters can extend MLL by almost 100% than On-Line emitters. The impact results of the emitter spacing on MLL indicated that, In-Line NPC emitters are able to perform the highest MLL while the