J. Soils and Crops 30 (2) 264-267, December 2020

ISSN 0971-2836 (p)
ISSN 2582-2756 (e)

PRESSURE - DISCHARGE RELATIONSHIP ON NON-PRESSURE COMPENSATING EMITTERS IN DRIP IRRIGATION SYSTEM

A. Sathishkumar[1], E. Subramanian[2], K . Sindhuja[3] and P. Rajesh[4]

ABSTRACT

The experiment was conducted to determine the allowable pressure variation for five different design discharge drippers. The different types of on line emitters namely 2 lph (litre hour^{-1}), 4 lph,6 lph,8 lph and 16 lph design discharge spiral path emitters were used in this study. Ten emitters of each type were tested at 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8 and 2.0 ksc operating pressure heads. Design standards recommended that about ± 10% variation in emitter discharge alone the irrigation line and over the field is permissible. Information on the allowable lateral pressure variation for various types of emitter is essential in designing an efficient drip irrigation system. Results of this study revealed that, the range of operating pressure head for various discharge emitters to give ± 10% variation of discharge from the design discharge are; for 2 lph non-pc dripper 1 ksc to 1.8 ksc, for 4 lph non-pc dripper 0.8 ksc to 1.4 ksc, for 6 lph non-pc dripper 0.8 ksc to 1.2 ksc, for 8 lph non-pc dripper 0.8 ksc to 1.2 ksc and for 16 lph non-pc dripper 0.8 ksc to 1.4 ksc.

(Key words :Drip irrigation, pressure-discharge relationship, emitters, pressure)

INTRODUCTION

In drip irrigation, water is applied to each plant separately in small, frequent and precise quantities through emitters. It is the most advanced irrigation method with the highest application efficiency. It also leads to easy adoption for chemigation and automation. The conventional irrigation methods do not apply water efficiently and distribute uniformly causing water losses due to conveyance, seepage and deep percolation especially in light textured soil (Mane *et al.,* 2014).Drip system permits the controlling of discharge and flexibility in time of water application. It saves water to an extent of 30 to 70 per cent without significantly affecting the crop yield (Jafari and Nazir, 2019). The capacity of the emitters available in the market varies from 2 to 16 lph. These are categorized as pressure and non-pressure compensating emitters. Emitter discharge rate is the amount of water discharged by emitter unit^{-1} time. The units frequently used are gallons hour^{-1} (gph) or litres hour^{-1} (lph).The discharges of water from emitters are measured in the field by collecting discharge from emitters for a selected period of time. There will be variability between the measured emitter discharge rates. Some variability is to be expected, but too much emitter discharge variability or variability increasing over time can be a source of concern for more information on discharge uniformity. Pressure measurements should be taken to gain a picture of the operating pressure throughout the drip system. The pressure measurement be taken from the head system to the system's tail end. From the inlet end of laterals to the tail ends. If pressures seem to be varying significantly (greater than 10-20%) within the system, more measurements are warranted. In drip irrigation, the emitter discharge changes as operating pressure changes excepting in complete pressure compensating emitters. An emitter is a very important component of drip irrigation system. The discharge through emitters is directly dependent on the pressure at the emitter's inlet line. The pressure variation along the lateral line is maintained due to frictional losses, resulting in decreased emitter discharge rate along the line. The discharge variation sensitivity to pressure was dependent upon flow regime and cross-sectional area of flow of emitter. For a particular type of emitter, discharge variation within the acceptable limit can be achieved by limiting the lateral line pressure variation. The relationship between operating pressure head and average emitters discharge can be approximately considered as linear relationships for operating pressure heads among the allowable maximum and minimum operating pressures.In order to study the relationship between the operating pressure of the system and discharge of emitter, the pressure-discharge relationship for different discharge drippers was formulated. Drippers with different design discharge rates were installed in the lateral lines and the

1. Teaching Assistant, Dept. of Agronomy, Agricultural College and Research Institute, TNAU, Madurai - 625 104
2. Asstt. Professor, Dept. of Agronomy, Agricultural College and Research Institute, TNAU, Madurai - 625 104
3. Ph.D., Scholar, Dept. of Genetics and Plant Breeding, Annamalai University, Chidambaram - 608002
4. Asstt. Professor, Dept. of Crop Management, RVS AC, Thanjavur-613 402

actual discharges for various operating pressures were recorded for arriving pressure-discharge relationship for uniform application of water.

MATERIALS AND METHODS

The experiment was conducted at Anbil Dharmalingam Agricultural College and Research Institute, Trichy - 620009, Tamil Nadu during 2011-2012. The college is located at 10Ú 45'N latitude, 78Ú 36'E longitude with an attitude of 85 m above MSL.The drip irrigation components already installed in the college were utilized for the study. The drip irrigation system was installed with hydro cyclone filter, fertigation device, disc filter and pressure gauges. In sub main line, 5 laterals were laid out and non- pressure compensating drippers of different discharges 2 lph, 4 lph, 6 lph, 8 lph and 16 lph were fixed in these 5 laterals. For pressure adjustment, the bye-pass valve installed in the inlet pipeline from the water was used.Water was pumped from a bore well using 5 HP submersible motor and pump and the delivery line was connected to the micro irrigation system with one bye-pass valve arrangement. By adjusting the discharge in the bye-pass assembly, the pressure was adjusted for measuring the discharge of emitters installed in the laterals.Five laterals with non-pressure compensating drippers of 2 lph, 4 lph, 6 lph, 8 lph and 16 lph design discharge respectively in each laterals were installed. Discharge measurements were taken up for different operating pressures *viz.,* 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8 and 2.0 ksc. The observations were taken up at 10 points in each of the lateral with different discharge drippers. The observations were repeated for different pressures for 3 times and the average discharge rate was arrived.For measuring the discharges of different discharge drippers, cans are placed under the selected drippers in each lateral and water was collected over a specified time. The collected discharge was measured using standard measuring jar. The discharge from the selected drippers was measured after collecting the discharge for a specified time in millilitres (time^{-1} in minutes). Then the discharge in litres hour^{-1} (lph) was arrived. The operating pressure of the system was adjusted to 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8 and 2.0 ksc operating pressures using the bye-pass arrangement. For each pressure, discharge was collected in the selected drippers of all the 5 laterals.The discharges of different non–pressure compensating emitters were measured by collecting the discharges for a known period of time. The discharges are converted to litres hour^{-1}.

RESULTS AND DISCUSSION

Data regarding the discharge of water collected at different times with varied pressure are presented in Figure 1, 2, 3, 4 and 5. The data revealed that, there was vast difference in discharges for various pressures. When the pressure is very low i.e., between 0.2-0.8 ksc, the discharge of 2 lph non –pc dripper was far below the design discharge.The discharge rate was 60% to 25% lesser than the design discharge of water. When the pressure is 1.0 ksc and up to 1.8 ksc the discharge variation was found to be between 6-8%. The variation of discharge at 2.0 ksc pressure was 15% from the design discharge. The discharges observed for the non-pc emitter of 4 lph design discharge shown that, there was a deviation of 6-8% from design discharge (4 lph), when the system was operated between 0.8 ksc and 1.4 ksc. The deviation was more than 10% when the operating pressure of the system was at 0.2, 0.4, 0.6, 1.8 and 2.0 ksc.The data on discharges of non-pc emitter of 6 lph operated at various pressures revealed that, there was much variation in discharges. When the system was operated at low pressures (0.2, 0.4 and 0.6 ksc) and at high pressures (1.4-2.0 ksc), there was discharge variation of more than 10%. When the operating pressure was between 0.8 and 1.2 ksc the discharge variation from the design discharge was less than 10%.The discharges recorded at various pressures between 0.2 ksc and 2 ksc and with 8 lph non- pc dripper indicated that, the variation of discharges with different pressures was in the range of 0.6 to 60 per cent. The variation of discharge from design discharge increased by more than 10% when the pressure exceeds 1.2 ksc and when the pressure is equal or lower than 0.6.

The data recorded on discharges in 16 lph non-pc dripper showed that, the variation in discharge from the design discharge was up to 42.5% when the operating pressure of the system was very low (0.2 ksc) and up to 23.6% when the operating pressure was very high (2 ksc). The variation of discharge was within ±10% when the operating pressure of drip system was in the range of 0.8 to 1.4 ksc.The deviation of discharge from the design discharge of 2 lph, 4 lph, 6 lph 8 lph and 16 lph non-pc drippers was up to 60% when the pressure is too high (2 ksc) or too low (0.2 ksc). Values of allowable lateral pressure variation were found to be different for various types of emitters which could be due to variation in their design characteristics. It may not be efficient to operate the micro irrigation system by increasing or decreasing the operating pressure head to produce the desired average emitter discharge for the soil wetted patterns required by crop root development.If the system is operated at very high or very low pressures and the time of irrigation, if it is calculated based on design discharge of emitters, it will be more if operated under high pressure causing over irrigation and will not be sufficient to give the required quantum of water if operate under low pressures. Increase in irrigation system pressure, emitter flow rates also started to increase as reported by Dogan (2010). According to Sarkar *et al.* (2019), if the flow variation value of a drip system is less than 10%, its performance is considered as excellent; if it is within 10–20% range then the drip system can be considered as good. The results are in line with the findings of Sharma (2013). The efficiency of drip irrigation system lies with the uniform application of water to the root zone of the crop.

If the system is operated within a range of pressure head so that the discharge variation is ± 10% of the design discharge, then this will satisfy the drip irrigation design criteria. The uniformity of application will not be affected if operated in this range. From this study it can be concluded that the range of operating pressure head for various discharge emitters to give ± 10% variation of discharge from the design discharge are; for 2 lph non-pc dripper 1 ksc to 1.8 ksc, for 4 lph non-pc dripper 0.8 ksc to 1.4 ksc, for 6 lph non-pc dripper 0.8 ksc to 1.2 ksc, for 8 lph non-pc dripper 0.8 ksc to 1.2 ksc and for 16 lph non-pc dripper 0.8 ksc to 1.4 ksc.

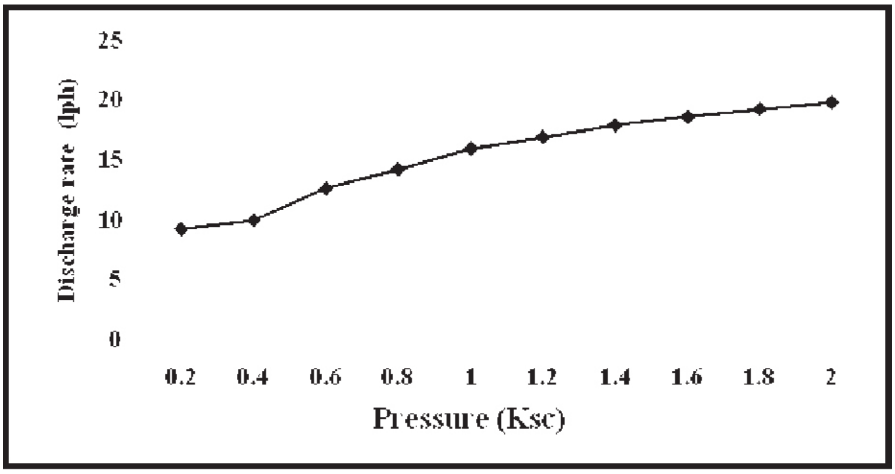

Figure. 1. Discharge rate of 2 lph Non-Pc dripper at different pressures

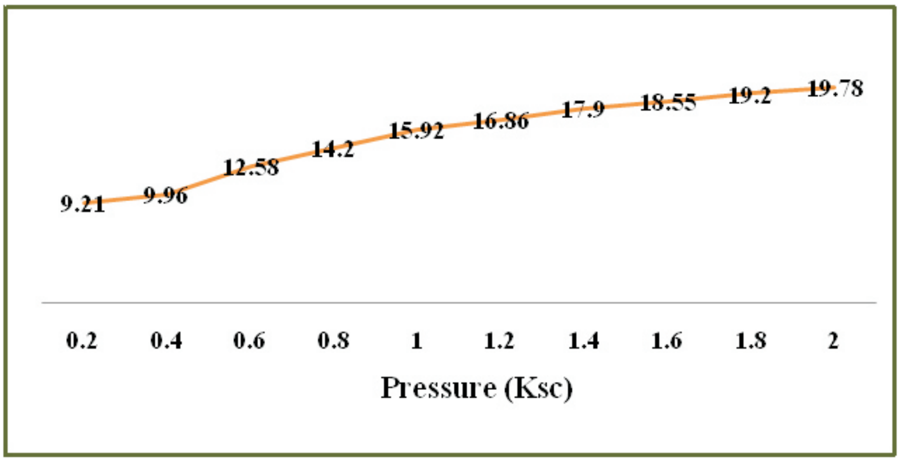

Figure 2. Discharge rate of 4 lph Non-Pc dripper at different pressures

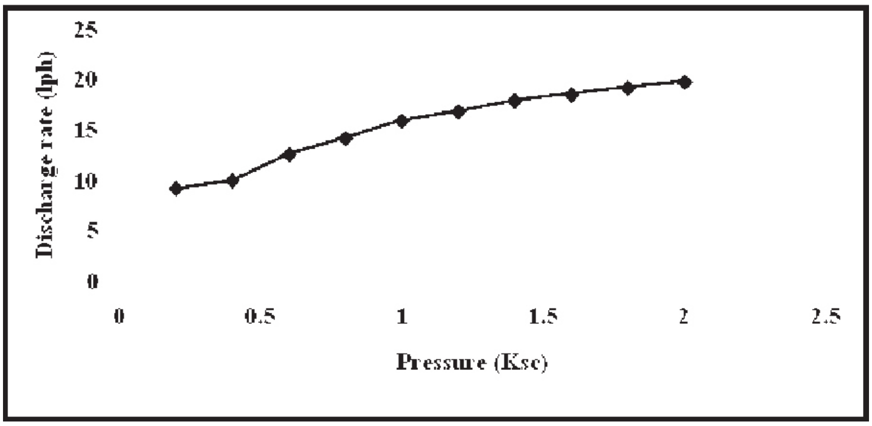

Figure 3. Discharge rate of 6 lph Non-Pc dripper at different pressures

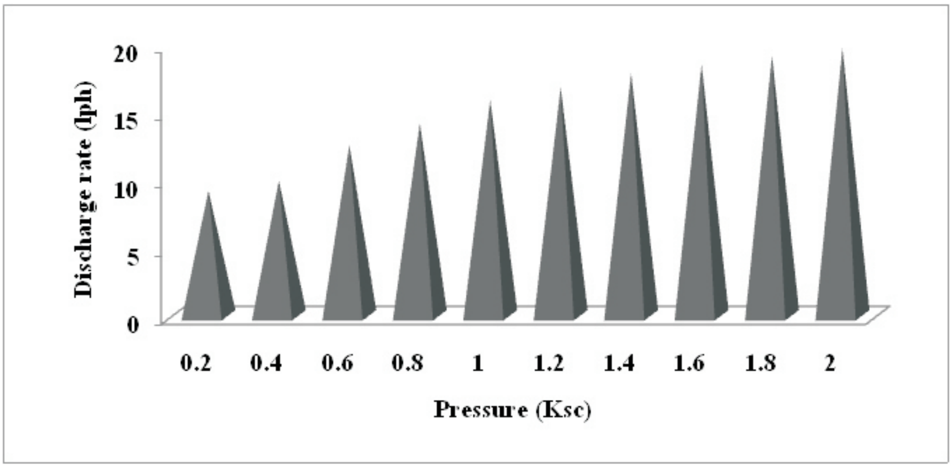

Figure 4. Discharge rate of 8 lph Non-Pc dripper at different pressures

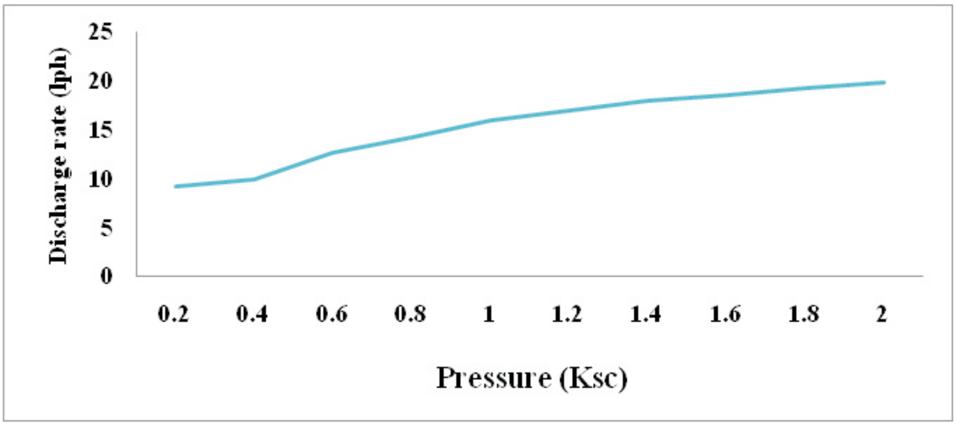

Figure 5. Discharge rate of 16 lph Non-Pc dripper at different pressures

REFERENCES

Dogan, E. 2010. Effects of drip irrigation system pressure fluctuations on drip lateral emitter flow rate and diameter change. J. Agric. Sci. **16**: 235-241.

Mane, M.S., S.K. Jagtap, B.L. Ayare and R.T. Thokal, 2014. Response of cucumber crop (*Cucumis sativus* L.) to drip irrigation system under various mulches. J. Soils and Crops. **24** (1): 193-200.

Sarkar, K.K., A. Hossain, K.F.I. Murad, S.K. Biswas, F. Akter, R.P. Rannu, M. Moniruzzaman, N.N. Karim and J. Timsina, 2019. Development and evaluation of an emitter with a low-pressure drip-irrigation system for sustainable eggplant production. Agri. Engineering.**1**: 376-390.

Sharma, Pankaj, 2013. Hydraulic performance of drip emitters under field condition. J. Agric. and Veterinary Sci.**2** (1): 15-20.

Zafari, J.K. and K.M. Nazir, 2019.A review on drip fertigation on field crops.International J. Eng. Res. & Technol.**8** (11): 722-729.

Rec. on 10.08.2020 & Acc. on 25.08.2020