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RESEARCH ARTICLE

Performance evaluation of the products of different drip irrigation companies

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ABSTRACT

The research was carried out at Puriya Park Farm, K. K. Wagh College of Agricultural Engineering and Technology, Nashik, in October 2014. The performance of drip products manufactured by different companies *viz.*, Company A, Company B and Company C was evaluated. Two NPC emitters of 4 lph and 8 lph were tested at operating pressure ranging from 0.5 to1.25 kg/cm^2 and one PC emitter of 4 lph discharge was tested at same operating pressure range. Also, the emission uniformity (EU) and co-efficient of uniformity (CU) of drip system was worked out. In 4 lph and 8 lph NPC drippers manufactured by Company A, discharge variation with respect to pressure was less as compare to standard discharge values of Company B and Company C. In 4 lph PC drippers manufactured by Company B, discharge variation with respect to pressure was very less as compared to standard discharge values of Company A and Company C.

KEY WORDS : Drip, Performance evaluation

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INTRODUCTION

The field application efficiency in most traditional irrigation methods is still very low, typically less than 50 per cent (sprinkler irrigation) and often as low as 30 per cent (surface irrigation) (Molden *et al.*,1998 and Mane and Ayare, 2007). The excessive application of water generally entails losses because of surface run-off from the field and deep percolation below the root zone within the field. Drip irrigation method allow for much more uniform distribution as well as more precise control of the amount of water applied and also decreases nutrient leaching. These systems are water saving, energy saving and weeds and disease control methods. In future there is a need of giving knowledge about micro irrigation; its importance and maintenance to the farmer in easy way.

For achieving high efficiency of water, use of drip irrigation is one of the most appropriate technologies in modern irrigated agriculture with the great potential (Mane *et al.*, 2006). It also leads itself to easy adoption for chemigation and automation. Drip system permits controlling of discharge and flexibility in time of water application. It saves water to the extent of 30 to 70 per cent without significantly affecting the crop yield.

Today, there are number of drip manufacturing companies available in the market. But these companies provide variety of products to the farmers of various qualities at different rates. The farmers are unaware of performance of product and they select the product having lower cost. Therefore, the present investigation was undertaken to enable the farmers to select most appropriate products of specific company (Nandu *et al.*, 2011).

EXPERIMENTAL PROCEDURE

The research was carried out at Puriya Park Farm, K. K. Wagh College of Agricultural Engineering and Technology, Nashik, Maharashtra, India, in October 2014. The performance of drip product of different companies was evaluated with various performance parameters. The selection of lateral for testing was done on the basis of commonly used diameter of lateral *i.e*. 16 mm size. The emitters selected were 4 lph and 8 lph NPC and 4 lph PC, manufactured by Company A, Company B and Company C. These emitters were tested at different pressures ranging from 0.50 to 1.25 kg/cm^2 with an increment of 0.25 kg/cm^2.

Components of drip irrigation system :

– Water conveying system
– Laterals
– Emitters
– Sprinkler heads with riser pipe
– Catch cans
– Drip testing unit
– Fitting accessories
– Pressure gauge

Set-up for drip testing unit :

Drip testing unit was used to test the various drippers of different companies. The emitters were spaced at 30 cm on the 4 m lateral having 16 mm diameter. The emitters were tested at different pressure ranging from 0.5 to 1.25 kg/cm^2 with an increment of 0.25 kg/cm^2.

Evaluation parameters for drip system:

Pressure discharge relationship, emission uniformity and co-efficient of uniformity were used to evaluate the performance of products from different drip companies *viz.,* Company A, Company B and Company C.

Pressure discharge relationship:

The lateral was joined with the emitters of 4 lph to the inlet pipe. Then the pressure of 0.5 kg/cm^2 was adjusted with the help of control valve. The catch cans were kept below each of the emitter for collecting the discharge through emitters. Then the system was operated for 5 min. The depth of water collected in each cylinder was measured in ml and then converted into lph. The pressure discharge relationship was determined by using the following formula (Keller and Karmelli, 1974):

$$\mathbf{q = K_e H^X}$$

where,

q = Discharge rate of dripper (lph)

K_e= Discharge co-efficient

H= Pressure head (m)

X = Dripper flow exponent

The same procedure was repeated for various companies emitters.

Emission uniformity (EU):

The system was operated for 5 min and the volume of water collected in each catch can was measured. The emission uniformity was determined by using the following formula (Keller and Karmelli, 1974):

$$\mathbf{EU = (q_{min}/q_{avg}) \times 100}$$

where,

EU= Emission uniformity (%)

q_{min} = Minimum emitter discharge (lph)
q_{avg} = Average emitter discharge (lph).

Uniformity co-efficient (UC):

UC was determined by Christiansen's formula (Michael, 1978) as under,

$$UC = \left[1 - \left(\frac{\Sigma X}{Mn}\right)\right] x100$$

where,
UC = Co-efficient of uniformity (%)
M= Average value of all observations
n= Total number of observation points
X = Numerical deviation of all observation

EXPERIMENTAL FINDINGS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Pressure discharge relationship for emitters:

The observations of operating pressure and corresponding discharges were recorded.

NPC Emitters (4 lph):

With increase in pressure discharge increased, for 4 lph NPC drippers manufactured by Company A (Table 1).

With increase in pressure from 0.5 kg/cm^2 to 1.25 kg/cm^2, discharge increased from 1.44 lph to 4.06 lph, for 4 lph NPC emitters manufactured by Company B (Table 2).

With increase in pressure from 0.5 kg/cm^2 to 1.25 kg/cm^2, discharge increased from 1.50 lph to 4.1 lph, for 4 lph NPC emitters manufactured by Company C which means that discharge increased with increase in operating pressure.

Table 1 : Average discharge of 4 lphNPC emitter (Company A) at different operating pressure

Sr. No.	Operating pressure (kg/cm^2)	Calculated discharge (lph)	Standard discharge (lph)
1.	0.50	1.55	2.90
2.	0.75	2.90	3.30
3.	1.00	3.85	4.0
4.	1.25	4.10	4.20

Table 2 : Average discharge of 4 lphNPC emitter (Company B) at different operating pressure

Sr. No.	Operating pressure (kg/cm^2)	Calculated discharge (lph)	Standard discharge (lph)
1.	0.50	1.44	2.90
2.	0.75	2.80	3.40
3.	1.00	3.80	4.00
4.	1.25	4.06	4.40

Table 3: Average discharge of 4 lphNPC emitter (Company C) at different operating pressure

Sr. No.	Operating pressure (kg/cm^2)	Calculated discharge (lph)	Standard discharge (lph)
1.	0.50	1.50	2.80
2.	0.75	2.90	3.40
3.	1.00	3.80	4.01
4.	1.25	4.10	4.45

(Table 3).

NPC Emitters (8 lph):

With increase in pressure, discharge increased for 8 lph NPC dripper, manufactured by Company A (Table 4).

It was observed that, as the operating pressure increased from 0.5 to 1.25 kg/cm^2, discharge increased from 4.20 lph to 7.91 lph, for 8 lph NPC emitters manufactured by Company B. (Table 5).

It was observed that with increase in pressure, the discharge also increased but there was variation in the calculated discharge as compared to the standard discharge given by Company C for 8 lph NPC emitters. (Table 6).

PC Emitters:

It was observed that with increase in pressure, there was variation in the discharge to small extent as per manufacturer's standard for 4 lph PC drippers manufactured by Company A (Fig. 1).

It was observed that with increase in pressure, there was change in discharge. There was less variation in

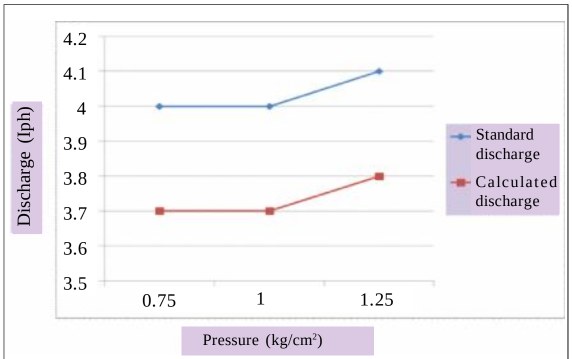

Fig. 1 : Pressure discharge relationship observed for 4 lph PC emitter (Company A)

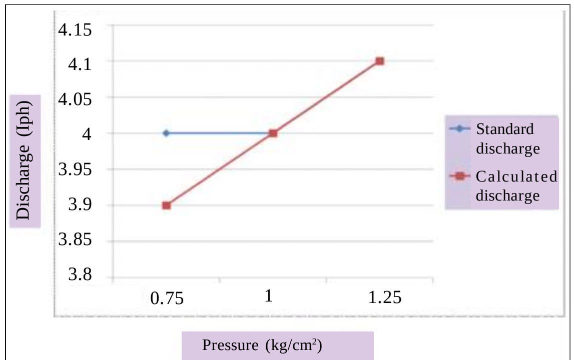

Fig. 2 : Pressure discharge relationship observed for 4 lph PC emitter (Company B)

Table 4 : Average discharge of 8lphNPC emitter (Company A)at the different operating pressure

Sr. No.	Operating pressure (kg/cm^2)	Calculated discharge (lph)	Standard discharge (lph)
1.	0.50	4.42	6.00
2.	0.75	5.70	6.95
3.	1.00	7.10	8.00
4.	1.25	7.83	8.50

Table 5 : Average discharge of 8lphNPC emitter(Company B) at the different operating pressure

Sr. No.	Operating pressure (kg/cm^2)	Calculated discharge (lph)	Standard discharge (lph)
1.	0.50	4.20	6.07
2.	0.75	4.52	7.06
3.	1.00	6.56	8.00
4.	1.25	7.91	8.75

Table 6 : Average discharge of 8lphNPC emitter (Company C) at different operating pressure

Sr. No.	Operating pressure (kg/cm^2)	Calculated discharge (lph)	Standard discharge (lph)
1.	0.50	4.10	6.0
2.	0.75	5.40	6.9
3.	1.00	6.50	7.02
4.	1.25	7.70	8.65

calculated and standard discharge. 4 lph PC drippers manufactured by Company B gave uniform discharge than drippers manufactured by Company B (Fig. 2).

With increase in operating pressure, the average discharge remained nearly same. There were minor variations in the discharge for the emitter manufactured by Company C (Fig. 3).

Emission uniformity (EU):

NPC emitters (4 lph):

It was observed that the minimum value of EU was 96.55 per cent at operating pressure of 0.75 kg/cm^2 and maximum value of EU was 98.70 per cent for operating pressure of 1.00 kg/cm^2, which means that for uniform distribution of water in the field, operating pressure should be kept at 1.00 kg/cm^2 (Table 7).

The maximum value of EU was 99.93 per cent at pressure of 1.0 kg/cm^2. Hence, for obtaining uniform distribution of water throughout field, system should be operated at 1.0 kg/cm^2 pressure for 4 lph NPC emitter manufactured by Company B (Table 8).

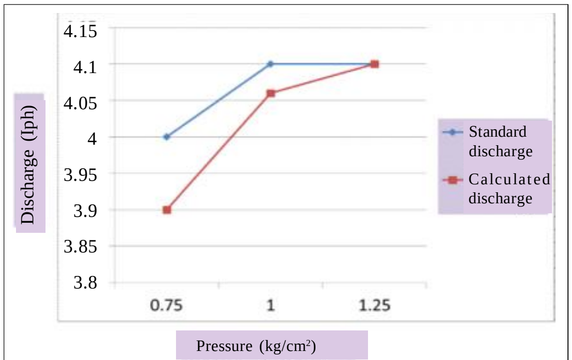

Fig. 3 : Pressure discharge relationship observed for 4 lph PC emitter (Company C)

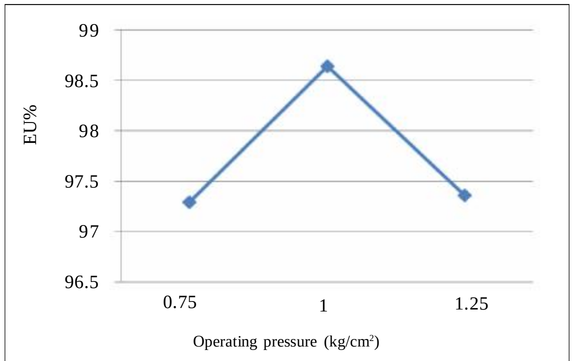

Fig. 4 : Variation in EU with operating pressure for 4 lph PC emitter (Company A)

Table 7: Variation in EU for different operating pressure for 4 lph NPC emitter (Company A)

Sr. No.	Operating pressure (kg/cm^2)	Emission uniformity (%)
1.	0.50	96.77
2.	0.75	96.55
3.	1.00	98.70
4.	1.25	97.68

Table 8: Variation in EU for different operating pressure for 4 lph NPC emitter (Company B)

Sr. No.	Operating pressure (kg/cm^2)	Emission uniformity (%)
1.	0.50	97.22
2.	0.75	98.21
3.	1.00	99.93
4.	1.25	99.01

Table 9 : Variation in EU for different operating pressure for 4 lph NPC emitter (Company C)

Sr. No.	Operating pressure (kg/cm^2)	Emission uniformity (%)
1.	0.50	96.66
2.	0.75	98.96
3.	1.00	98.40
4.	1.25	99.26

The minimum value of EU was 96.66 per cent at operating pressure of 0.50 kg/cm^2 and maximum value of EU was 99.26 per cent at the operating pressure of 1.25 kg/cm^2, which means that for obtaining uniform distribution of water in the field, the operating pressure should be kept 1.25 kg/cm^2 for the emitter manufactured by Company C (Table 9).

PC emitters (*4 lph*):

It was observed that within the operating pressure 0.75 to 1.25 kg/cm^2 EU varied to small extent. The minimum EU was 97.29 per cent at operating pressure of 0.75 kg/cm^2 and maximum EU was 98.64 per cent at operating pressure of 1.00 kg/cm^2 (Fig. 4).

It was observed that within the operating pressure 0.75 to 1.25 kg/cm^2, EU doesn't varied upto the large extent. The minimum EU was 99.25 per cent at operating pressure of 1.00 kg/cm^2 and the maximum EU was 98.64 per cent at the operating pressure 0.75 kg/cm^2 (Fig. 5).

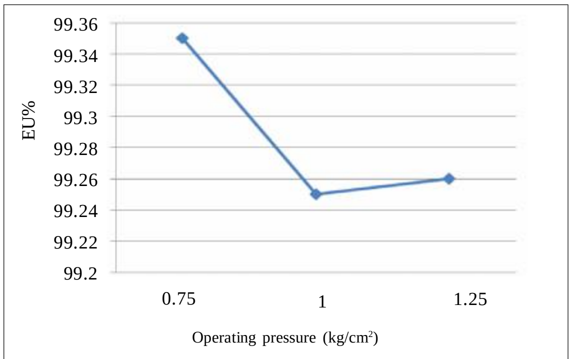

Fig. 5: Variation in EU with operating pressure for 4 lph PC emitter (Company B)

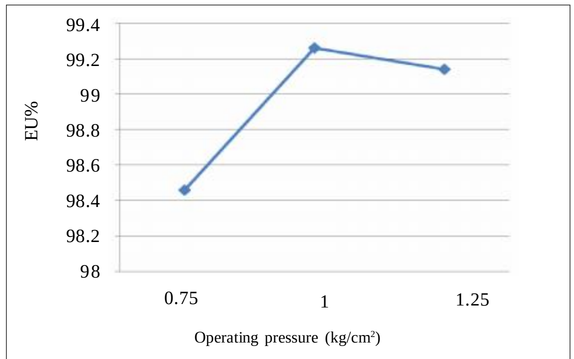

Fig. 6: Variation in EU with operating pressure for 4 lph PC emitter (Company C)

Table 10 : Variation in EU for different operating pressure for 8 lph NPC emitter (Company A)

Sr. No.	Operating pressure (kg/cm^2)	Emission uniformity (%)
1.	0.50	98.19
2.	0.75	99.47
3.	1.00	99.43
4.	1.25	99.17

Table 11. Variation in EU for different operating pressure for 8 lph NPC emitter (Company B)

Sr. No.	Operating pressure (kg/cm^2)	Emission uniformity (%)
1.	0.50	98.45
2.	0.75	97.23
3.	1.00	98.62
4.	1.25	99.53

Table 12 : Variation in EU for different operating pressure for 8 lph NPC emitter (Company C)

Sr. No.	Operating pressure (kg/cm^2)	Emission uniformity (%)
1.	0.50	98.45
2.	0.75	97.23
3.	1.00	98.62
4.	1.25	99.53

The minimum EU was 98.46 per cent at operating pressure 0.75 kg/cm^2 and maximum EU was 99.26 per cent for operating pressure 1.00 kg/cm^2. Hence, for obtaining uniform distribution of water throughout field, system should be operated at 1.0 kg/cm^2 pressure for 4 lph PC emitter manufactured by Company C (Fig. 6).

NPC emitters (8 lph):

It was observed that the minimum value of EU was 98.19 per cent at operating pressure of 0.50 kg/cm^2 and maximum value of EU was 99.47 per cent for operating pressure of 0.75 kg/cm^2. There were minor variations in EU at operating pressure varying from 0.50 to 1.25 kg/cm^2. Hence, uniform distribution of water will be possible if system is operated at 0.75 kg/cm^2 (Table 10).

The minimum value of EU was 97.23 per cent at operating pressure of 0.75 kg/cm^2 and maximum value of EU was 99.53 per cent at operating pressure of 1.25 kg/cm^2, which means that to obtain uniform distribution of water in the field, operating pressure should be kept at 1.25 kg/cm^2 for 8 lph NPC emitter by Company B (Table 11).

The minimum value of EU was 97.68 per cent at operating pressure of 0.50 kg/cm^2 and maximum value of EU was 99.67 per cent at operating pressure of 1.25 kg/cm^2, which means that to obtain uniform distribution of water in the field, operating pressure should be kept at 1.25 kg/cm^2 for emitter manufactured by John Deere. The variation in EU was very small within the operating pressure ranging from 0.75 to 1.25 kg/cm^2 (Table 11).

Conclusion:

In 4 lph and 8 lph NPC drippers manufactured by Company A, discharge variation with respect to pressure was less as compared to standard discharge of Company B and Company C. In 4 lph PC dripper manufactured by Company B, discharge variation with respect to pressure was very less as compared to standard discharge values of Company A and Company C.

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