RESEARCH PAPER | International Journal of Agricultural Engineering | Volume 8 | Issue 1 | April, 2015 | 75–78
e ISSN–0976–7223 ■ Visit us : *www.researchjournal.co.in* ■ DOI: 10.15740/HAS/IJAE/8.1/75-78

Study on performance of venture injector under different inlet and outlet pressure for banana plantation

■ S.C. BHANGARE, S.N. BANSUDE AND S.S. SHIRKOLE

Received : 21.01.2015; **Revised :** 25.02.2015; **Accepted :** 09.03.2015

See end of the Paper for authors' affiliation

Correspondence to :

S.N. BANSUDE
Department of Soil and Water Conservation Engineering, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, AKOLA (M.S.) INDIA
Email : bansude.sushilkumar@gmail.com

■ **ABSTRACT :** Optimum and efficient use of fertilizers is one of the major advantages of drip irrigation systems. Success of micro irrigation system lies in precise application of fertilizers. The investigation was carried out to study the performance of ventury injector manufactured by Jain Irrigation Systems Ltd. under normal field conditions, near Talsande village of the Kolhapur district of Maharashtra state. The different pressure combinations were maintained at upstream and downstream side of the ventury injector. The different inlet pressures of 1.0, 1.2, 1.4, 1.6, 1.8 and 2.0 kg/cm^2 were selected with different outlet pressure combinations of 0.1, 0.3 and 0.5 at the outlet of the ventury injector. Injection rate and injection efficiency were calculated for different varying inlet and outlet pressure combinations using relationship suggested by manufacturer of the ventury injector. The maximum injection rate in case of ventury (74 lps) was achieved at inlet pressure of 1.8 kg/cm^2 and outlet pressure of 0.1 kg/cm^2 with pressure differential of 1.7 kg/cm^2. Injection efficiency of ventury was observed maximum at 95 per cent at 2 kg/cm^2 inlet pressure and 0.1 kg/cm^2 outlet pressure fallowed by 94.4 per cent at 1.8 kg/cm^2 inlet pressure and 0.1 kg/cm^2 outlet pressure and 94 per cent at 1.6 kg/cm^2 inlet pressure and 0.1 kg/cm^2 outlet pressure.

■ **KEY WORDS :** Application of fertilizers, Ventury injector, Injection rate, Injection efficiency

■ **HOW TO CITE THIS PAPER :** Bhangare, S.C., Bansude, S.N. and Shirkole, S.S. (2015). Study on performance of venture injector under different inlet and outlet pressure for banana plantation. *Internat. J. Agric. Engg.*, **8**(1) : 75-78.

The right combination of water and nutrients is the key for high yield and the quality of produce. Fertigation (application of fertilizer solution with drip irrigation) has the potential to ensure that the right combination of water and nutrients is available at the root zone, satisfying the plants total and temporal requirement of these two inputs. Fertigation saves fertilizers, as it permits applying fertilizer in small quantities at a time matching with the plants nutrient need. Besides, it considers eco-friendly as it avoids leaching of fertilizers. Liquid fertilizers are best suited for fertigation however in India, inadequate availability and high cost of liquid fertilizers restricts their uses. Hence, there is a need of selecting a proper fertigation system for application of the fertilizers with water.

Ventury injector is the most commonly used device for fertigation through drip irrigation because of its simplicity, ease in use and low cost of operation without additional pump set. A ventury fixed in main line creates pressure differential and allows the fertilizer solution to flow in the main water line (Michael, 2001). The suction rate of the ventury is depends on its size, pressure differential in ventury and the viscosity of the fluid. Ventury can be used to inject fertilizer at constant dilution ratio (Sivnappan *et al.*, 1987).

In Asia, bananas are widely produced fruit crops in

the countries like India, Philippines, Thailand, Indonesia and China. In India, 20 per cent of cultivable area of horticulture crops is under banana plantation. In recent years the yield of banana plantation per hector has been increased due to innovation and adaptation of new techniques in the cultivation such as tissue culture. To get maximum high quality and marketable fruit production of banana fruit crop, it is, therefore, necessary to apply proper dose of fertilizers (Vanudia and Lacertosa, 2001).

The present investigation was carried out to find out the maximum injection rate and the maximum injection efficiency of the 3/4" ventury injector manufactured by the Jain Irrigation System Ltd. out of the different inlet-outlet pressure combination for banana plantation.

METHODOLOGY

The investigation was carried out at Talasande village, District Kolhapur of Maharashtra state under normal field condition. The different components required for the experimental set up are pressure gauges, bypass valve, gate valve, plastic bucket, stopwatch and the ventury. All these components are fixed in the drip irrigation system as suggested by the manufacture of ventury injector for carried out the study.

Calculation of injector rate :

The different pressures were maintained at upstream and downstream side of the venture. Upstream pressures of 1.0, 1.2, 1.4, 1.6, 1.8 and 2.0 kg/cm^2 are maintained. With each upstream pressure, different downstream pressure was fixed for evaluating the injection rate of different venture under varying inlet and outlet pressure differentials.

A bucket containing solution (Potassium nitrate soluble grade, 13:0:46) was placed near the ventury system. Then pressures of upstream and downstream side was adjusted and stabilized at predetermined level with the help of bypass valve. The suction tube of venture was placed in the bucket of water. It allows the suction of water in bucket was recorded. The volume change in the water bucket divided by operating time gives the injection rate of the venture. The same procedure was repeated with different upstream and downstream pressure.

$$\text{Injection rate} = \frac{\text{Volume water sucked}}{\text{Operating time}} \quad \text{..... (1)}$$

Measurement of discharge :

The discharge of the system at its outlet was calculated for each corresponding upstream and downstream pressure. The variation of discharge with each combination of upstream and downstream pressure was observed.

Table 1 : Different inlet- outlet pressure combinations and their corresponding injection rates and outlet discharges

Inlet pressure (kg/cm^2)	Outlet pressure (kg/cm^2)	Pressure differential (kg/cm^2)	Injection rates (lph)	Outlet discharge (lph)	Discharge injection ratio	Injection efficiency (%)
	0.1	0.9	61.2	25812	421.76	90.0
1	0.3	0.7	44.0	23256	528.55	70.0
	0.5	0.5	24.0	21312	888.00	50.0
	0.1	1.1	70.0	24264	346.63	91.7
1.2	0.3	0.9	54.8	22752	415.18	75.0
	0.5	0.7	34.0	21780	640.59	58.3
	0.1	1.3	72.0	25812	358.50	92.9
1.4	0.3	1.1	68.4	258112	369.80	78.6
	0.5	0.9	63.0	25308	413.53	64.3
	0.1	1.5	73.6	26892	365.38	93.8
1.6	0.3	1.3	69.2	25308	365.72	81.3
	0.5	1.1	63.6	24768	389.43	68.8
	0.1	1.7	74.0	25308	342.00	94.4
1.8	0.3	1.5	71.2	24552	344.83	83.3
	0.5	1.3	64.4	22608	351.06	72.2
	0.1	1.9	69.6	16920	243.10	95.0
2.0	0.3	1.7	65.8	16524	245.89	85.0
	0.5	1.5	60.0	15696	261.60	75.0

Injection efficiency :

The efficiency of the venture was calculated from the known values of the upstream and downstream pressure (which gives the operating

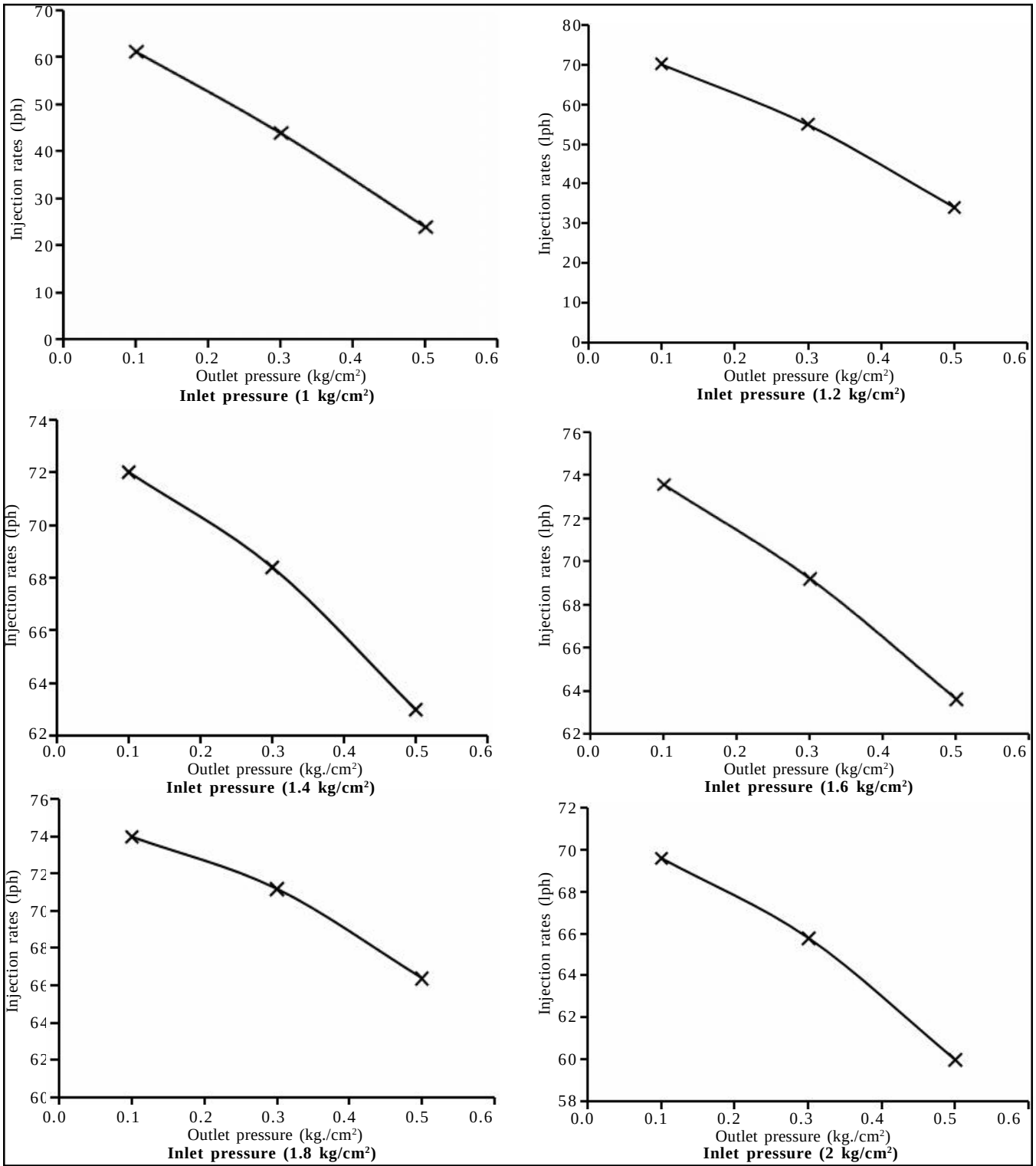

Fig. 1 : Outlet pressures vs. injection rate for respective inlets pressures

pressure range for the system) and the injection rate of the venture under the varying operating pressure range. Injection efficiency of venture was calculated by using the following relationship as suggested for venture injector by BIS (1997).

$$\eta_{inj} = \left(\frac{SOR}{OP_{max}} \right) \times 100 \quad \text{..... (2)}$$

where, N_{inj} is injection efficiency of venture in (%), SOR is suction operating pressure range for venture injection system in kg/cm^2 (SOR = OP_{max} - OP_{mim}), OP_{max} is maximum pressure allowed at the inlet of venture, kg./cm^2 and OP_{mim} is minimum pressure allowed at the inlet of venture, required to operate the venture in kg/cm^2.

RESULTS AND DISCUSSION

The injection rate and injection efficiency of a 3/4" ventury injector manufactured by the Jain Irrigation Systems Ltd. were calculated as suggested by the manufacturer for the different inlet and outlet pressure combinations under field condition. Calculated injection rate and injection efficiency for different inlet pressures of 1.0, 1.2, 1.4, 1.6, 1.8 and 2.0 kg/cm^2 with different outlet pressure combinations of 0.1, 0.3 and 0.5 kg/cm^2 at the outlet of the ventury injector are presented in the Table 1.

From the Table 1 it is seen that, the maximum injection rate was observed 74 (lph) for inlet pressure of 1.8 kg/cm^2 and outlet pressure of 0.1 kg/cm^2. The maximum discharge of 25812 (lph) was observed for the inlet pressure of 1.0 kg/cm^2 with outlet pressure of 0.1 kg/cm^2. Injection efficiency of the ventury injector was observed maximum 95 per cent at inlet pressure of 2 kg/cm^2 with outlet pressure of 0.1 kg/cm^2, followed by 94.4 per cent at inlet pressure of 1.8 kg/cm^2 with outlet pressure of 0.1 kg/cm^2 and 93.8 per cent at inlet pressure of 1.6 kg/cm^2 with outlet pressure of 0.1 kg/cm^2 (Rajput *et al*., 2004).

Graphs plotted between outlet pressures vs. injection rate for respective inlets pressures are shown in the Fig. 1. From the graphs it is clear that, as outlet pressure increased, the injection rate decreased for all the respective inlet pressures.

Conclusion :

From all above observations it can be concluded that, the ventury injector 3/4" manufactured by Jain Irrigation Systems Ltd., gave better injection efficiency (95 %) for the working inlet pressure of 2.0 kg/cm^2 and outlet pressure of 0.1 kg/cm^2 with injection rate of 69.6 lph and discharge of 16920 lph. Inlet pressure of 2.0 kg/cm^2 with outlet pressure of 0.1 kg/cm^2 can be used for the fertigation purpose to the banana plantation.

Authors' affiliations:

S.C. BHANGARE, Department of Farm Power and Machinery Engineering, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, AKOLA (M.S.) INDIA

S.S. SHIRKOLE, Department of Food Process Engineering, National Institute of Technology, ROURKELA (ODISHA) INDIA

REFERENCES

BIS (1997). Indian standards fertilizer and chemical injection system, Part-I, *Ventury Injection*. ISI 14483. 1pp.

Chawala, J.K. and Narda, N.K. (2001). Economy in water and fertilizer use in trickle fertigated potato. *Irrig. & Drain.*, **50** (2): 129-137.

Clapp, R.S. (2000). Fertigation technique for growing tomatoes. *Internat. Water & Irrig.*, **22** (4) : 24-28.

Michael, A.M. (2001). *Irrigation theory and practices*. Vikas Publishng House Pvt. Ltd., NEW DELHI, INDIA.

Rajput, T.B.S., Patel, Neelam and Kumar, Mukesh (2004). Performance evaluation of commercially available venturies under varying inlet and outlet pressure differential. *J. Agric. Engg.*, **41** (2): 38-41.

Shani, M. and Spair, E. (1994). Advance irrigation management. *J. Agron*., **12** (1): 17-19.

Shivanappan, R.K., Kumar, I.O. Padam and Kumar, V. (1987). *Drip irrigation*. Keerthi Publication House Pvt. Ltd., Coimbatore (T.N.) INDIA.

Vanudia, S. and Lacertosa, G. (2001). Fertigation of horticultural crop. *Irrig. Dren..*, **48** (1): 20-24.