Indian J. Hort. 67(3), September 2010: 418-420

Short communication

Response of micro-irrigation and fertigation on high-value vegetable crops under control conditions

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Presently, adoption of drip irrigation in India is increasing and about 5.50 lakh hectares area is covered under drip irrigation under various crops. Furthermore, there is good potential for adoption of drip irrigation and use of water soluble fertilizers with drip system, *i.e.* fertigation technique for achieving better productivity and quality in different crops with the Government support (Jade, 5). The micro-irrigation also enables use of fertilizers, pesticides and other soluble chemicals along with the irrigation water more economically and thus enhancing quality of produce and yield (Singh *et al*., 11). Micro-irrigation is a highly efficient method of water application to crops, which substantially saves water and fertilizer, increases yield besides improving quality of produce and reducing labour. In the recent years there has been a serious concern of global shortage of water. It is estimated that in India by 2025, 33 per cent of India's population will live under severe scarcity conditions (Chauhan, 4). Low temperature and frost injury during winter season are the limiting factors for growing high value vegetables like tomato and capsicum in north India. Low and medium cost polyhouses are the viable approach for cultivation of high value vegetables during winter and spring season (Chandra *et al.*, 3). Nutrients play a major role in achieving maximum yield in vegetable crops when grown under polyhouse then open field grown conditions (Singh *et al.*, 11). Considering all these factors, present experiment was conducted to find out minimum use of water, optimum spacing and compact use of nutrients for tomato and capsicum for maximum yield and returns through drip irrigation under polyhouse in north Indian plains.

The experiment was conducted in the Division of Agricultural Engineering IARI, New Delhi for three years in a polyhouse using multi-span fan-pad cooling system. The experiment was conducted in FRBD design with two irrigation treatments (Drip and Flood irrigation method), three dropper/ plant spacings (30, 45, 60 cm and row to row fixed 60 cm) and two nitrogen application methods, i.e. through fertigation and as a top dressing. The indeterminate tomato hybrid 'Rakshita' and capsicum 'California Wonder' were planted in first week of October during each year. Seedlings were grown in small bags (8 cm × 4 cm size). Seedling of 25-30 days was transplanted in appropriate treatment in randomized plots in polyhouse. The soil was sandy-loam having a pH of 8.0. An uniform dose of FYM (2 kg/ m^2), phosphate (200 kg/ ha) given as SSP and potash (250 kg/ ha) given as MOP was applied as basal dose in all treatments in both the crops at 15 days before planting and after 30 days of planting in split doses at every 25 days intervals during all the years The tomato plants were trained vertically with the help of plastic strings and all the primary branches were removed at weekly intervals and their fruits were allowed to set only on the main stem flower clusters. Insecticides and fungicides were used as per crop requirement.

A pressurized drip system was installed on 50,000 l capacity RCC water tank with filter system, PVC main supply pipe (size 30 mm), sub main LLDPE laterals (size 12 mm) and dripper (size 0.6 PEE) with water discharge capacity of 2 l/h. The sub-main laterals were fixed at 60 cm apart and drippers were fixed at 30, 45 and 60 cm along the laterals. All sub-main laterals were controlled by gate valve system. Nitrogen was provided by ventury system of fertigation. The drip system was operated at alternate days or at two days interval for 10 min. in each crop. Flood irrigation was provided by using plastic pipes (2 cm size) as per need or moisture content in each crop. Data on yield (kg/ plant), disease incidence (%), weed (%), water and time saving percentage were recorded and calculated in randomly selected five plants in each plot.

Observations recorded on different parameters are summarized in Tables 1 and 2. The methods of pressurized drip irrigation had significantly increased yield (11.38 and 12.50 kg/m^2) and net income (65.40 and 67.78 Rs/m^2) of tomato and capsicum as compared to flood irrigation in all the years. The crop yield improved by 65.40% in tomato and 67.70% in capsicum when the crop was irrigated through drop irrigation. Maximum water saving, minimized weeds, diseases and total time of irrigation were found in drip irrigation method in toth the crops. However, flood irrigation

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Table 1. Response of micro-irrigation, fertigation and dripper spacing on tomato production under controlled conditions.

Treatment	Marketable yield (kg/m²)*	Net income (Rs/m²)	Increased yield in drip irrigation as against flood irrigation (%)	Water saving (%)	Disease incidence (%)	Weed incidence (%)	Total irrigation time (h)
Irrigation method							
Drip	11.38	43.80	65.40	43.23	05.50	30.20	12
Flood	06.88	16.30	-	-	20.50	100.00	42
Dripper spacing							
30 cm	12.20	52.00	77.32	30.12	8.30	35.50	12
45 cm	10.40	34.00	51.16	35.29	5.30	30.30	12
60 cm	09.20	22.00	33.72	44.35	3.50	25.70	12
Nitrogen application							
Fertigation	10.85	38.50	57.70	40.24	04.50	20.50	12
Top dressing	08.67	21.50	26.07	38.23	15.70	35.60	12

*CD at 5% Irrigation method = 1.57, Dripper spacing = 1.15 and N application = 1.65

Table 2. Response of micro-irrigation, fertigation and dripper spacing on capsicum production under controlled conditions.

Treatment	Marketable yield (kg/m²)*	Net income (Rs/m²)*	Increased yield in drip irrigation as against flood irrigation (%)	Water saving (%)	Disease incidence (%)	Weed incidence (%)	Total irrigation time (h)
Irrigation method							
Drip	12.50	75.00	67.78	42	04.50	30.20	12
Flood	07.45	14.40	-	-	12.50	100.0	42
Dripper spacing							
30cm	13.20	83.40	77.18	30	7.70	35.50	12
45cm	10.30	48.60	38.25	35	5.80	30.30	12
60cm	09.42	38.04	26.44	40	4.90	25.70	12
Nitrogen application							
Fertigation	12.15	70.80	63.08	35	04.50	20.50	12
Top dressing	09.58	55.20	28.59	30	12.60	35.60	12

CD at 5% Irrigation method = 1.35, Dripper spacing = 1.12 and N application = 1.02

*Total cost of cultivation on average of tomato= 70 Rs/m² and capsicum = 75 Rs/m²

The average selling price of tomato 10 Rs/kg and capsicum 12 Rs/kg.

had no water saving, more occurrence of weeds, high disease incidence and total time. Similar findings were recorded by Ashwani Kumar (1), Khan (7), Mahajan *et al.* (8), Singh *et al.* (11), and Thiyagarajan *et al.* (13).

The dripper spacing at 30 cm recorded significantly positive effect on yield and net returns as compared to 45 cm spacing in both tomato and capsicum. The yield was 77.32% greater in tomato and 77.18% greater in capsicum at 30 cm wide dipper spacing as compared to flood irrigation method. However, wider dripper spacing (60 cm) saved more water, total irrigation time, minimized the diseases and weeds incidence as compared to closer dripper spacing in both the crops under polyhouse condition in each years (Tables 1 & 2). This imrpovement is due to the fact that closer spacing accomedates higher plant population, resulting more

number of fruits, which increases total yield and net returns. Earlier, Chauhan (4), Singh *et al.* (10), Singh and Naik (12) also reported similar findings.

Fertigation resulted in maximum yield in tomato (10.85 kg/m²) and capsicum (12.15 kg/m²), net income, minimal disease, weed incidence and saved water and total irrigation time as compared to top dressing method in both tomato and capsicum under polyhouse condition during each year (Tables 1&2). The fertigation of nitrogen had recorded 25.14 and 26.82% higher yield in tomato and capsicum, respectively as compared to top dressing method. Similar observation was also recorded by Chakarborty *et al.* (2), Chauhan, (4), Jade (5), Khan (7), and Shivashankar *et al.* (9).

It was observed that drip irrigation enhanced the fruit yield, net income and minimized the time, weeds and diseases in both the crops. The closer spacing of dripper (30 cm) produced higher yield and net-income. Whereas, wider spacing saved the maximum water, minimized weed and disease incidences in both the vegetable crops. The study reveals that yield of tomato and capsicum could be significantly enhanced through drip irrigation method in polyhouse conditions.

REFERENCES

1. Ashwani Kumar. 1996. *Production and Prospects of Drip Irrigation System in India. Strategies for Horticulture Development in India*. Department of Agriculture and Co-operation, New Delhi, 239 p.
2. Chakaraborty, D., Singh, A., Kumar, A., Uppal,, U.S. and Khanna, K. 1998. Effect of fertigation on nitrogen dynamics of broccoli. *Workshop on Micro-irrigation and Sprinkler Irrigation Systems*, New Delhi.
3. Chandra, P., Singh, A.K., Behera, T.K. and Shrivastava, R. 2003. Influence of graded levels of nitrogen, phosphorus and potassium on yield, and quality of polyhouse grown tomato (*Lycopersicon esculentum*) hybrids. *Indian J. Agric. Sci*. **73**: 497-99.
4. Chauhan, H.S. 2005. Standardization and certification of micro-irrigation and fertigation *International. Conference on Plasticulture and Precision Farming*, 17-21 Nov. 2005, New Delhi, pp. 319.
5. Jade, B.D. 2005. Fertigation is a master key for bumper yield and quality production. *International Conference on Plasticulture and Precision Farming,* 17-21 Nov, New Delhi, pp. 185.
6. Kahlon, M.S. and Mand, R.S. 2005. A study on comparison between drip and furrow method of irrigation in tomato under two irrigation levels. *International Conference on Plasticulture and Precision Farming,* 17-21 Nov, New Delhi, pp. 202.
7. Khan, M.M. 2000. Management of irrigation and fertigation under greenhouse in India. *International Seminar on Sprinkler and Micro-irrigation*, Jalgaon, 10-12 February, pp. 25.
8. Mahajan, G. and Singh, K.G. 2005. Response of greenhouse tomato to drip irrigation and fertigation. *International Conference on Plasticulture and Precision Farming,* 17-21 Nov, New Delhi, pp. 189.
9. Shivashankar, K., Khan, M.M. and Farooqui, A.A. 1998. Fertigation studies with water soluble fertilizer in crop production. *Annual Report. Univ. of Agril. Sciences, Bangalore.*
10. Singh, A.K., Singh, A.K., Gupta, M.J. and Shrivastava, R. 2004. Effect of variety and spacing on growth yield and economy of capsicum under greenhouse condition. *Prog. Hort*. **36**: 321-30.
11. Singh, H.P., Samuel, J.C. and Ashwani Kumar. 2000. Microirrigation in horticulture crops. *Indian Hort*. **45**: 37-43.
12. Singh, R.V. and Naik, L.B. 1990. Effect of nitrogen, phosphorus and plant spacing on sweet pepper (*Capsicum annum*). *Haryana J. Hort. Sci.* **19**: 168-72.
13. Thiyagarajan, G., Ranghaswami, K., Arunadevi, R., Uma devi, D., Kumar, R. and Muralidharan, J. 2005. Deficit irrigation effect on tomato with drip irrigation system. *International Conference on Plasticulture and Precision Farming,* 17-21 Nov, New Delhi, pp. 200.

Received: April, 2008; Revised: May, 2010;
Accepted : June, 2010